MERCURY

MerCruiser

#33 Service Manual

ECM 555 Diagnostics

Notice to Users of This Manual

Throughout this publication, dangers, warnings, cautions, and notices (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. These safety alerts follow ANSI standard Z535.6-2006 for product safety information in product manuals, instructions, and other collateral materials. **Observe them carefully!**

These safety alerts alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus common sense operation, are major accident prevention measures.

⚠ DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, could result in engine or major component failure.

IMPORTANT: Identifies information essential to the successful completion of the task.

NOTE: *Indicates information that helps in the understanding of a particular step or action.*

This manual has been written and published by the Service Department of Mercury Marine to aid our dealers' mechanics and company service personnel when servicing the products described herein. We reserve the right to make changes to this manual without prior notification.

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It is assumed that these personnel are familiar with marine product servicing procedures. Furthermore, it is assumed that they have been trained in the recommended service procedures of Mercury Marine Power Products, including the use of mechanics' common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the marine trade of all conceivable procedures and of the possible hazards and/or results of each method. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

Refer to dealer service bulletins, operation maintenance and warranty manuals, and installation manuals for other pertinent information concerning the products described in this manual.

Precautions

It should be kept in mind, while working on the product, that the electrical and ignition systems are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material into the cylinders which could cause extensive internal damage when the engine is started.

During any maintenance procedure, replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for reuse, care should be taken to select a replacement that matches the original.

Replacement Parts

Use of parts other than the recommended service replacement parts will void the warranty on those parts that are damaged as a result.

⚠ WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Mercury Marine products comply with U.S. Coast Guard rules to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these rules. When servicing the electrical and fuel systems, properly install and tighten all components.

Cleanliness and Care of Product

A Mercury Marine Power Product is a combination of many machined, honed, polished, and lapped surfaces with tolerances measured in the ten thousands of an inch/mm. When any product component is serviced, care and cleanliness are important. It should be understood that proper cleaning and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Personnel should not work on or under an engine that is suspended. Engines should be attached to work stands, or lowered to ground as soon as possible.

Manual Outline

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- A - General Information

2 - Troubleshooting
- A - Troubleshooting

3 - Diagrams
- A - Diagrams—Mechanical
- B - Diagrams—Integrated
- C - Diagrams—14 Pin
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General Information

1 A

Section 1A - General Information

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How To Use This Guide

This diagnostic guide is separated into three sections: General Information, Troubleshooting, and Wiring Diagrams.

General Information covers:

- General wiring information
- Engine Guardian description
- Warning chart

Troubleshooting covers:

- Basic scan tool information
- Symptom trouble chart
- Fault chart
- CDS

Wiring diagrams covers:

- Engine electrical harness
- Circuit diagrams
- 14-pin harness

Troubleshooting covers possible electrical and mechanical causes for engine faults on the scan tool. In wiring diagrams, the single circuit diagrams cover each sensor and subset of the electrical system of the engine. These two sections help the technician pinpoint problems occurring in the electrical system.

ECM and PCM Abbreviations

NOTE: *Throughout this manual the Computer Diagnostic System is often abbreviated as CDS.*

Abbreviation	Description
5 VDC PWR LO	5-volt ECM internal power supply low
5 VDC PWR 2 LO	5-volt ECM power supply low to SmartCraft Sensors (Not available on all models)
ACT	Air compressor temperature (F or C) sensor
ACT INPUT HI	Air compressor temperature sensor input is high
ACT INPUT LO	Air compressor temperature sensor input is low
ACT TMP Sec	Time spent in air compressor overheat
ACTIVE	Active fault state of sensors, switches, injectors, etc.
AT	Intake manifold air temperature (F or C) sensor
AT I NPUT HI	Air temperature (engine) sensor input is high
AT INPUT LO	Air temperature (engine) sensor input is low
AIR COM TMP	Air compressor temperature sensor (F or C)
AIRFLOW HI	Incoming airflow to engine is higher than expected
AIR TEMP CKTHI	Air temperature (engine) sensor circuit is high
AIR TEMP CKT LO	Air temperature (engine) sensor circuit is low
AIR TMP	Intake manifold air temperature (F or C) sensor
AVAILABLE PWR %	A normally functioning system will allow engine to make 100% power.
B+	Battery positive
BARO	Barometric pressure

Abbreviation	Description
BARO PSI	Barometric pressure (psi or kPa)
BAT	Battery positive terminal, battery or system voltage
BATT VOLT HIGH	Battery voltage is above the allowable limit
BATT VOLT LOW	Battery voltage is below the allowable limit
BLK PSI MIN	Block pressure minimum specification
BLK TEMP CKT HI	Engine block temperature sensor circuit is high
BLK TEMP CKT LO	Engine block temperature sensor circuit is low
BLOCK PRESS LOW	Engine block pressure below acceptable limit
BLOCK PSI	Inlet water pressure to block (PSI or kPa)
BLOCK PSI	Sec time spent with low water pressure to block
BLOCK PSI	Inlet water pressure (PSI or kPa)
BLOCK OVRHEAT	Engine block is overheating
BPSI INPUT HI	Block pressure sensor input is high
BPSI INPUT LO	Block pressure sensor input is low
BREAK-IN	Engine break-in routine
BREAKIN ACTIVE	Engine break-in routine is active
BREAK-IN LEFT	Time remaining in engine break-in routine
BREAKIN STR	Break-in strategy
BUFFER	An area used to temporarily store data
BUS +12 CAN	Bus 12-volt supply for SmartCraft
CALIB ID	Calibration ID of ECM
CAN	Controller area network
CAN ERR1	CAN wiring problem. Check ALL pins and terminators
CAN ERR2	CAN wiring problem. Check ALL pins and terminators
CAN ERR3	CAN wiring problem. Check ALL pins and terminators
CAN ERR4	CAN wiring problem. Check ALL pins and terminators
CAN ERR5	CAN wiring problem. Check ALL pins and terminators
CAN ERR6	CAN wiring problem. Check ALL pins and terminators
CAN ERR7	CAN wiring problem. Check ALL pins and terminators
CAN ERR8	CAN wiring problem. Check ALL pins and terminators
CAN ERR9	CAN wiring problem. Check ALL pins and terminators
CAN ERR10	CAN wiring problem. Check ALL pins and terminators
CHI	Customer helm interface (SC5000)
CKT	Circuit
CODE	Calibration ID of ECM
COOL TMP PRT	Coolant temp port (F or C) sensor
COOL TMP STB	Coolant temp starboard (F or C) sensor
COMP	Air compressor temperature sensor
COMP OVERHEAT	Air compressor temperature is above the allowable limit
COMP TEMP CKT HI	Air compressor temperature sensor circuit is high
COMP TEMP CKT LO	Air compressor temperature sensor circuit is low
COMP TMP	Air compressor temperature (F or C)
COMPRESS OVRHT	Air compressor temperature is above the allowable limit

Abbreviation	Description
CONN	Connector
CTP INPUT HI	Coolant temperature port sensor input is high
CTP INPUT LO	Coolant temperature port sensor input is low
CTP TMP	Sec time spent in overheat on the port bank
CTS INPUT HI	Coolant temperature starboard sensor input is high
CTS INPUT LO	Coolant temperature starboard sensor input is low
CTS TMP	Sec time spent in overheat on the starboard bank
CYL	Cylinder
DDT	Digital diagnostic terminal
DEC	Refers to a decreasing potentiometer reading in the electronic remote control. A decreasing potentiometer reads from high to low volts through its total travel range.
DEG	Degrees
DEMAND %	TPI% or TPS% ; On DTS models, this is ERC demand %
DEMAND DIFF	Faulty potentiometers in ERC
DIAG	Diagnostic
DINJ1 -- DINJ6 OPEN	Direct injector 1-6 circuit is open
DINJ1 -- DINJ6 SHORT	Direct injector 1-6 circuit is short
DIST	Distributor
DLC	Data link connector
DRIVE LUBE LO	Low drive lube reservoir
DRIVER POWER LO	Insufficient battery voltage or wiring problem
DTC	Diagnostic trouble code
DTS	Digital throttle and shift
DUAL CAN ERR	Wiring problem between CAN 1 and CAN 2
DVOM	Digital volt ohm meter
ECM 555	Electronic control module with a power PC 555 microcomputer
ECM ID ECM	Hardware revision level
ECM MEMORY ERR	ECM memory has been corrupted
ECM_TRIG1-8 OPEN	ECM spark trigger signal circuit 1-8 is open
ECM_TRIG1-8 SHORT	ECM spark trigger signal circuit 1-8 is short
ECT	Engine coolant temperature (F or C) sensor
EEPROM	Electronic erasable programmable read only memory
EMI	Electromagnetic interference
ENG	Engine
ENGINE ID	Engine identification
ENGINE RPM	Revolutions per minute of engine
ERC	Electronic remote control handle at the helm
ESC	Electronic shift control (actuator)
ESC CONTROL LOST	ESC cannot maintain in-gear position
ESC - NS POS DIFF	ESC determination of its position and neutral switch position don’t agree
ESC - ERC POS DIFF	ESC position (actuator's determination of its position) and commanded position do not agree.
ESC TIMEOUT	ESC actuator has not physically moved with respect to the ERC lever (demand) position.

Abbreviation	Description
EST	Electronic spark timing
EST 1-8	Electronic spark trigger signal to the ignition coil driver circuit
EST 1-8 OPEN	Electronic spark trigger signal circuit 1-8 is open
EST 1-8 SHORT	Electronic spark trigger signal circuit 1-8 is short
ETC CONTROL	Loss of electronic throttle control circuit
ETC STICKING	Electronic throttle control sticking or binding
ETC IDLE RANGE ETC	Is outside of its expected idle range
ETC MOTOR OPEN	Electronic throttle control motor is open (Not available on all models)
ETC MOTOR SHORT	Electronic throttle control motor is shorted (Not available on all models)
FINJ 1 - FINJ 8 OPEN	Fuel injector circuit 1-8 is open
FINJ 1 - FINJ 8 SHORT	Fuel injector circuit 1-8 is shorted
FPC TOTAL	Fuel per cycle per cylinder. Total fuel amount currently being used by engine.
FREEZE FRAME	A snapshot of captured engine data stored in ECM history
FUEL LEVEL	Boat tank fuel sender data
FUEL LVL CKT HI	Fuel level sensor circuit high (same as FUEL LVL IN HI)
FUEL LVL CKT LO	Fuel level sensor circuit low (same as FUEL LVL IN LO)
FUEL LVL CKT2 HI	Fuel level sensor circuit #2 high (same as FUEL LVL IN HI)
FUEL LVL CKT2 LO	Fuel level sensor circuit #2 low (same as FUEL LVL IN LO)
FUEL LVL IN HI	Fuel level sensor input is high
FUEL LVL IN LO	Fuel level sensor input is low
FUEL PRES CKT LO	Fuel pressure sensor circuit is low (not available on all models)
FUEL PRES CKT HI	Fuel pressure sensor circuit is high (not available on all models)
FUEL PSI CKT HI	Fuel pressure sensor circuit (same as Fuel Pres Input Hi)
FUEL PSI CKT LO	Fuel pressure sensor circuit low (same as Fuel Pres Input Lo)
FUEL PUMP CKT	Fuel pump circuit or relay fault
FUEL PUMP RLY	Fuel pump relay
GEAR POS DIFF ESC	Position sensor doesn’t agree with the shift switch
GND	Ground
GUARDIAN	Engine Guardian strategy is active
GRD LIMIT	Sec time spent in engine guardian
H20 IN FUEL	Water-in-fuel filter
H2O PRES CKT HI	Engine water pressure sensor circuit is high
H2O PRES CKT LO	Engine water pressure sensor circuit is low
HALL SENSOR	Hall effect (encoder/crank position) sensor
HALL SNSR STR	Hall effect (encoder/crank position) sensor strategy is active
HEAD OVRHT	Cylinder head is overheating
HEAD TEMP CKT HI	Cylinder head temperature sensor circuit is high
HEAD TEMP CKT LO	Cylinder head temperature sensor circuit is low
HEI	High energy ignition
HELM ADC CHECK	Command module reliability check or CAN bus problem
HIRES	Indicates a high-resolution potentiometer which has voltage readings that move from high to low to high through its entire range.
HORN	Horn driver (internal to ECM for non DTS models)

Abbreviation	Description
HORN OUTPUT	Warning horn system not functional (same as Warning Horn)
IAC	Idle air control
IAC OUTPUT	Idle air control valve or circuit fault
IAC PWM%	Idle air control valve duty cycle percent
IAT	Intake air temperature
IC	Ignition control
IDLE	Idle TPI=0%
IDLE MAP STR	Idle RPM MAP strategy (same as MAP Idle Check)
IGN	Ignition
IGN 1 -- IGN 8	Ignition coil for cylinders one thru eight
IGN PRI	Ignition coil primary
INC	An increasing potentiometer reading used in the electronic remote control. An increasing potentiometer reads from low to high volts through its total travel range
INJ	Injection
KNOCK SENSOR1	Knock sensor #1 (not available on all models) or KNK SNSR1
KNOCK SENSOR2	Knock sensor #2 (not available on all models) or KNK SNSR2
kPa	Kilopascal
KS	Knock sensor
KV	Kilovolts
LAKE/SEA	Lake or sea water temperature (F or C)
LED	Light emitting diode (Typically red in color)
LOW DRIVE LUBE	Low drive lube reservoir
LOW OIL SEC	Time spent on low oil reserve
MAP	Manifold absolute pressure sensor (psi or kPa)
MAP CKT HI	Manifold absolute pressure sensor circuit high (same as MAP INPUT HI)
MAP CKT LO	Manifold absolute pressure sensor circuit low (same as MAP INPUT LO)
MAP DIFF ERR	Both TPIs are functioning but MAP sensor calculations don’t agree, therefore the MAP sensor is suspected as faulty
MAP INPUT HI	MAP sensor input is high
MAP INPUT LO	MAP sensor input is low
MAP IDLE CHECK MAP	Sensor rationality/loss of vacuum check (not available on all models)
MAT	Manifold air temperature (F or C) (same as AT)
MAT CKT HI	Manifold air temperature circuit high (same as AT Input Hi)
MAT CKT LO	Manifold air temperature circuit low (same as AT Input Lo)
MAP	Manifold absolute pressure
MCM	MerCruiser marine
MDTC	Marine diagnostic trouble code
MIE	Mercury inboard engine
MIL	Malfunction indicator lamp
MPRLY	Main power relay
MPRLY BACKFEED	An external power source has bypassed the main power relay
MPRLY OUTPUT	Main power relay output circuit has a fault
mSec	Millisecond

Abbreviation	Description
NA (N/A)	Not available
NEUTRAL OVERSPD	Neutral gear overspeed
N/C	Normally closed
N/O	Normally open
OBD	On-board diagnostic
OIL INJ CNT	Number of counts of oil pump activation cycles
OIL LEVEL	Main oil tank sender data
OIL LVL BOAT LO	Oil level in boat tank is low
OIL LVL ENG LO	Oil reserve active on engine tank (Low Oil Switch)
OIL LVL CKT HI	Oil level sensor circuit is high
OIL LVL CKT LO	Oil level sensor circuit is low
OIL LVL IN HI	Oil level sensor input is high
OIL LVL IN LO	Oil level sensor input is low
OIL PMP Sec	Time spent with oil pump fault
OIL PRES LO	Oil pressure is low
OIL PRES CKT HI	Oil pressure sensor circuit high
OIL PRES CKT LO	Oil pressure sensor circuit low
OIL PSI	Engine oil pressure (psi or kPa)
OIL PSI CKT HI	Oil pressure sensor circuit high
OIL PSI CKT LO	Oil pressure sensor circuit low
OIL PSI STR)	Oil pressure strategy (not available on all models)
OIL PUMP	Oil pump electrical fault or wiring
OIL PUMP OUTPUT	Oil pump electrical fault or wiring
OIL QLTY CKT HI	Oil quality circuit high (not available on all models)
OIL QLTY CKT LO	Oil quality circuit low (not available on all models)
OIL REMOTE STR	Remote oil tank strategy (not available on all models)
OIL RESERVE STR	Oil reserve strategy is active (low oil switch has been activated)
OIL SYSTEM	Oil system fault
OIL TMP CKT HI	Oil temperature circuit high
OIL TMP CKT LO	Oil temperature circuit low
OIL TMP OVRHT	Oil temperature overheat
OVERSPEED	Overspeed or RPM limit
OVERSPEED	Engine has entered stage 0 of RPM limit (normal rev limit)
OVERSPEED 1	Engine has entered stage 1 of RPM limit (abnormal rev limit)
OVERSPEED 2	Engine has entered stage 2 of RPM limit (abnormal rev limit)
OVER TMP	Sec time in seconds spent in over heat condition
PADDLE WHEEL	Data used to calculate boat speed (frequency in hertz)
PADLE WHEEL STR	Paddle wheel strategy
PCM	Propulsion control module
PCM 555	Propulsion control module with a power PC555 microcomputer
PITOT	Pitot pressure sensor data for boat speed calculations
PITOT CKT HI	Pitot pressure sensor circuit high
PITOT CKT LO	Pitot pressure sensor circuit low

Abbreviation	Description
PITOT INPUT HI	Pitot pressure sensor input is high
PITOT INPUT LO	Pitot pressure sensor input is low
PORT EMCT CKT HI	Port exhaust manifold coolant sensor circuit high
PORT EMCT CKT LO	Port exhaust manifold coolant sensor circuit low
PORT EMCT OVRHT	Port exhaust manifold coolant temperature overheat
PORT HEAD OVRHT	Overheat on the port bank
PORT OVERHEAT	Overheat on the port bank
PROM	Programmable read only memory
PRT EMCT	Port exhaust manifold coolant temp (F or C)
PRT EMCT CKT HI	Port exhaust manifold coolant sensor circuit high
PRT EMCT CKT LO	Port exhaust manifold coolant sensor circuit low
PRT EMCT OVRHT	Port exhaust manifold coolant temperature overheat
PWR 1 VOLTS	Power supply 1 volts (internal to ECM) for sensors
PWR RLY	Main power relay
PWR RELAY OUTPUT	Main power relay output circuit has a fault (see FAQ)
PWR RELAY BACKFD	An external power source has bypassed the main power relay
PWR1 LOW	+5v sensor power supply is low
RAM	Random access memory
REF. HI	Reference high
REF. LO	Reference low
REVERSE OVERSPD	Reverse gear overspeed
ROM	Read only memory
RPM LIMIT SEC	Time spent in RPM limit (seconds)
RUN TIME HR.	Total run time in hours with this ECM
SC5000	Systemview 5000 display (CHI)
SEA PUMP CKT HI	Sea pump pressure sensor circuit high
SEA PUMP CKT LO	Sea pump pressure sensor circuit low
SEA PUMP PSI	Sea pump pressure (PSI or kPa)
SEA PUMP PSI LO	Sea pump pressure low
SEA TMP CKT HI	Sea/Lake temperature circuit high (same as SEA TMP IN HI)
SEA TMP CKT LO	Sea/Lake temperature circuit low (same as SEA TMP IN LO)
SEA TMP IN HI	Sea/Lake temperature sensor input is high
SEA TMP IN LO	Sea/Lake temperature sensor input is low
SEC	Secondary of ignition coil
SEC FINJ1- 6 OPEN	Secondary fuel injector circuit 1-6 is open
SEC FINJ1- 6 SHORT	Secondary fuel Injector circuit 1-6 is shorted
SHIFT	Neutral or in gear position
SHIFT ADAPT ERR	Check ESC components for binding. ESC actuator faulty?
SHIFT ANT SWITCH	Problem with shift anticipate switch or problem with outdrive
SHIFT DRV OVRHT	Internal ECM driver for shift actuator is overheating
SHIFT POS CKT HI	Shift position sensor input circuit is high
SHIFT POS CKT LO	Shift position sensor input circuit is low
SHIFT SWITCH	Faulty neutral switch or wiring

Abbreviation	Description
SMARTSTART ERR	DTS engine failed to see flywheel rotation when commanded to start. No engine RPM detected, no starter engagement?
STAR OVERHEAT	Overheat on the starboard bank
START SOLENOID	Open circuit to start solenoid
STBD HEAD OVRHT	Overheat on the starboard bank
STBD TEMP CKT HI	Coolant temperature starboard sensor input is high
STBD TEMP CKT LO	Coolant temperature starboard sensor input is low
STB EMCT	Starboard exhaust manifold coolant temp (F or C)
STB EMCT CKT HI	Starboard exhaust manifold coolant temperature circuit high
STB EMCT CKT LO	Starboard exhaust manifold coolant temperature circuit low
STB EMCT OVRHT	Starboard exhaust manifold coolant temperature overheat
STBD EMCT CKT HI	Starboard exhaust manifold coolant temperature circuit high
STBD EMCT CKT LO	Starboard exhaust manifold coolant temperature circuit low
STBD EMCT OVRHT	Starboard exhaust manifold coolant temperature overheat
STEER CKT HI	OutDrive steering position sensor circuit high
STEER CKT LO	OutDrive steering position sensor circuit low
STEER INPUT HI	OutDrive steering position sensor input is high (Not available on all models)
STEER INPUT LO	OutDrive steering position sensor input is low (Not available on all models)
SLV	Slave
SW	Switch
TACH	Tachometer
TERM	Terminal
TGAP	Crank position sensor (Trig) air gap
THERMOSTAT FAULT	Check cooling system components
TPS	Throttle position
TPI % or TPS %	Throttle position indicator (demand) percent
TPI or TPS	Throttle position indicator or throttle position sensor
TPI ALL ERR	None of the two TPIs and MAP agree. Faulty wiring?
TPI1 DIFF ERR	MAP Sensor range = TPI2 but TPI1 doesn’t agree
TPI1 CKT HI	TPI #1 sensor circuit is high
TPI1 CKT LO	TPI #1 sensor circuit is low
TPI 1 INPUT HI	TPI #1 sensor circuit is high
TPI 1 INPUT LO	TPI #1 sensor circuit is low
TPI 1 NO ADAPT	Throttle position indicator #1 has a mechanical system, linkage, or connection fault. ECM software will not proroperly adapt.
TPI1 ADAPT ERR	Same as above
TPI 1 RANGE HI	TPI #1 is above the allowable high range
TPI 1 RANGE LO	TPI #1 is below the allowable low range
TPI 1 VOLTS	Throttle position indicator #1 volts
TPS1 CKT HI	Throttle position sensor #1 circuit high (same as TPI 1 input hi)
TPS1 CKT LO	Throttle position sensor #1 circuit low (same as TPI 1 input lo)
TPS1 NO ADAPT	Throttle position sensor #1 has a mechanical system, linkage, or connection fault. ECM software will not properly adapt (same as TPI 1 No Adapt)
TPI2 DIFF ERR	MAP sensor range = TPI1 but TPI2 doesn’t agree

Abbreviation	Description
TPI2 CKT HI	Throttle position indicator #2 circuit high
TPI2 CKT LO	Throttle position indicator #2 circuit low
TPI2 NO ADAPT	Throttle position indicator #2 has a mechanical system, linkage, or connection fault. ECM software will not properly adapt
TPI2 RANGE HI	Throttle position indicator #2 range high
TPI2 RANGE LO	Throttle position indicator #2 range low
TPI2 VOLTS	Throttle position indicator #2 volts
TRANS OVERHEAT	Transmission overheat
TRIM	Trim sender data
TRIM CKT HI	Trim sensor circuit high (same as TRIM INPUT HI)
TRIM CKT LO	Trim sensor circuit low (same as TRIM INPUT LO)
TRIM INPUT HI	Trim sensor input is high
TRIM INPUT LO	Trim sensor input is low
V	Volts
VAC	Vacuum
in.Hg	Inches of mercury
VR SENSOR	Variable reluctance (encoder/crank position) sensor
VR SNSR STR	Variable reluctance (encoder/crank position) sensor strategy
WARNING HORN	Warning horn system not functional (horn output)
WATER IN FUEL	Water-in-fuel filter
WATER PRES LO	Water pressure to engine is low WOT wide open throttle TPI=100%
WOT	Wide-open throttle
XCHK DEMAND DIFF	SC5000 or command module not equal to PCM cross check of demand value (Incorrect positions used when configuring levers at CHI, faulty CHI, or ECM)
XCHK SHIFT DIFF	SC5000 or command module not equal to PCM cross check of shift position

Precautions

⚠ WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Mercury Marine products comply with U.S. Coast Guard rules to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these rules. When servicing the electrical and fuel systems, properly install and tighten all components.

⚠ WARNING

Performing service or maintenance without first disconnecting the battery can cause product damage, personal injury, or death due to fire, explosion, electrical shock, or unexpected engine starting. Always disconnect the battery cables from the battery before maintaining, servicing, installing, or removing engine or drive components.

⚠ WARNING

Fuel is flammable and explosive. Ensure the key switch is off and the lanyard is positioned so that the engine cannot start. Do not smoke or allow sources of spark or open flame in the area while servicing. Keep the work area well ventilated and avoid prolonged exposure to vapors. Always check for leaks before attempting to start the engine and wipe up any spilled fuel immediately.

⚠ WARNING

Improper installation of brass fittings or plugs into the fuel pump or fuel filter base can crack the casting, causing a fuel leak and possible fire or explosion. Always install fittings and plugs correctly, and do not tighten with power tools.

NOTICE

Failure to provide sufficient cooling water will damage the water pump and cause the engine to overheat. Provide a sufficient supply of water at the water inlets during operation.

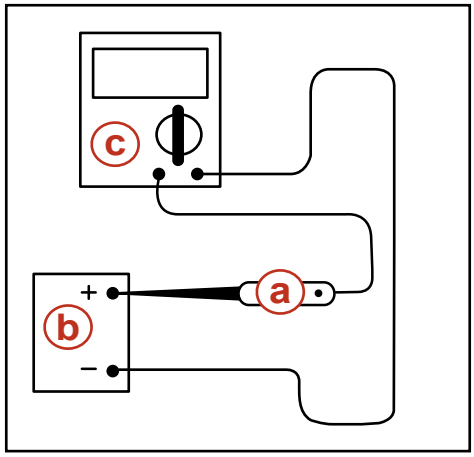
Service Precautions

Observe the following:

- Before removing any ECM system component, disconnect both battery cables.
- Never start the engine without the battery being solidly connected.
- Never separate the battery from the on-board electrical system while the engine is operating.
- Never disconnect battery cables from the charging system while the engine is operating.
- When charging the battery, disconnect it from the boat's electrical system.
- Ensure that all cable harnesses are connected and that battery connections are clean.
- Never connect or disconnect the wiring harness at the ECM when the switch is in the on position.
- Before attempting any electric arc welding, disconnect the battery leads and the ECM connectors.
- When steam cleaning engines, do not direct the steam cleaning nozzle at ECM system components. Steam can cause corrosion of the terminals or damage of components.
- Use only the test equipment specified in the diagnostic charts; other test equipment may either give incorrect results or damage good components.
- All voltage measurements using a voltmeter require a digital voltmeter with a rating of 10 MegΩ input impedance.
- When using a DMT to perform voltage measurements, switch to the off position when connecting the DMT to the circuitry being tested.
- When a test light is specified, a low-power test light must be used. Do not use a high-wattage test light.

While a particular brand of test light is not suggested, a simple test, as shown below, on any test light will ensure it to be safe for system circuit testing.

1. Connect an accurate ammeter (such as the DMT) in series with the test light being tested and power the test light ammeter circuit with the battery.



17127

a - Test Light
b - Battery
c - Ammeter

IMPORTANT: If the ammeter indicates less than 3/10 amp current flow (.3 A or 300 mA), the test light is safe to use. If the ammeter indicates MORE than 3/10 amp current flow (0.3 A or 300 mA), the test light is not safe to use.

NOTE: *Using a test light with 100 mA or less rating may show a faint glow when the test actually states no light.*

General Information

Electrostatic Discharge Damage

Electronic components are often designed to carry very low voltage and are susceptible to damage caused by electrostatic discharge. Even less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes 4,000 volts for a person to even feel the effect of a static discharge.

A person can become statically charged in many ways. The most common methods are by friction and by induction. An example of charging by friction is a person sliding across a seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily grounds the circuit. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage electronic components. Use care when handling and testing electronic components.

Wiring Harness Service

Service Marine engine control circuits contain many special design features not found in standard land vehicle wiring. Environmental protection is used extensively to protect electrical contacts and proper splicing methods must be used.

IMPORTANT: Before component replacement and during normal troubleshooting procedures, visually inspect any questionable mating connector.

The proper operation of low amperage input and output circuits depends upon good continuity between circuit connectors. Mating surfaces should be properly formed, clean, and likely to make proper contact. Some typical causes of connector problems are listed below.

1. Improperly formed contacts or connector housing.
   - Damaged contacts or housing due to improper connection.
   - Corrosion, sealer, or other contaminants on the contact mating surfaces.
2. Incomplete mating of the connector halves during initial assembly or during subsequent troubleshooting procedures.
3. Tendency for connectors to come apart due to vibration and temperature cycling.
4. Terminals not fully seated in the connector body.
5. Inadequate terminal crimps to the wire.

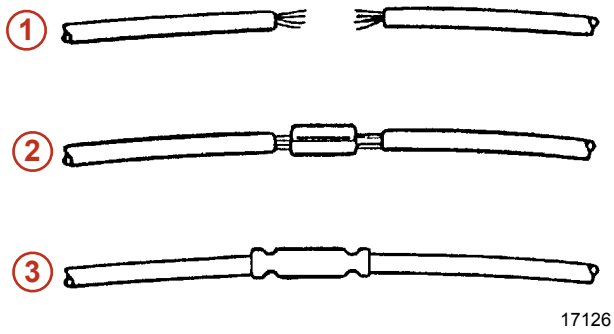
Wire harnesses should be replaced with the appropriate replacement part. For the correct harness, refer to the specified part numbers. When signal wires are spliced into a harness, only use specified wire the same gauge as the existing harness in accordance with ABYC E11.

With the low current and voltage levels found in the system, carefully solder splices and create the best possible connection. Refer to **Wire Repair**.

Use care when probing a connector or replacing connector terminals. Avoid possible shorts between opposite terminals. If this happens, certain components can be damaged. Always use jumper wires with the corresponding mating terminals between connectors for circuit checking. NEVER probe through connector seals, wire insulation, secondary ignition wires, boots, or covers. Microscopic damage or holes will result in eventual water intrusion, corrosion, or component or circuit failure.

Wire Repair

Locate the damaged wire and repair as shown:



17126

1. Remove insulation as required.
2. Splice two wires together using splice clips and rosin core solder.
3. Cover the splice with a heat-shrink sleeve to insulate.

Wiring Connector Service

Most connectors in the engine compartment are protected against moisture and dirt that could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock that secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may locate the open circuit condition. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Some connectors look similar but are serviced differently. Replacement connectors and terminals are listed in the **Mercury Precision Parts and Quicksilver Accessories Guide**.

Ensure that the connector seals are not deformed or crushed when mating the connectors together.

Intermittent Problems

IMPORTANT: Intermittent problems may or may not store a fault. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual check for the following conditions:

- Poor mating of the connector halves or a terminal not fully seated in the connector body.
- Intermittent problems may or may not store a fault. The fault must be present to locate the problem.

All connector terminals in the problem circuit should be carefully checked for proper contact tension.

- Poor terminal-to-wire connection (crimping). Remove the terminal from the connector body to check.

The vessel may be driven with a digital multimeter connected to a suspected circuit. An abnormal voltage when malfunction occurs is a good indication that there is a fault in the circuit being monitored.

A diagnostic tool, such as CDS, can be used to help detect intermittent conditions. The CDS allows manipulation of wiring harnesses or components with the engine not operating, while observing the scan tool readout. The CDS can also be connected and observed while operating the vessel.

If the problem seems to be related to certain parameters that can be checked on the scan tool, they should be checked while operating the vessel. If there does not seem to be any correlation between the problem and a specific circuit, use the diagnostic tool data to see if there is any change in the readings that might indicate intermittent operation.

The CDS is also an easy way to compare the operating parameters of a poorly operating engine with those of a known good one. For example, a sensor may shift in value but not set a fault. Comparing the sensor readings with those of the typical scan tool data readings may uncover the problem.

Using the CDS tool can save time in diagnosis and prevent the replacement of good parts. To use the tool successfully, the technician must understand the system being diagnosed and the CDS operation and limitations. The technician should read the CDS tool operating manual provided by the manufacturer to become familiar with operation of the tool. Also, an electronic help program is included with the CDS tool.

To check loss of fault memory, disconnect the TP sensor and idle the engine. Attach the CDS tool. The fault TPS1 CKT Lo should be stored and kept in memory when the ignition is turned "OFF." If not, the ECM/PCM is faulty. When this test is completed, clear the fault.

An intermittent problem may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- Poor ECM/PCM grounds.
- An electrical system interference caused by a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Improper installation of electrical options such as lights, ship-to-shore radios, and sonar.

PCM 555 Ignition System

The propulsion control module (PCM 555) ignition system consists of a battery, PCM 555 controller, main power relay (MPR), fuse, crankshaft position sensor (CPS), camshaft position sensor (CMP), two ignition coil harnesses, ignition coils (one per cylinder), spark plug wires and spark plugs.

PCM 555 Controller

The PCM 555 controls all ignition system functions, and constantly adjusts dwell and spark timing. It uses engine speed and position information from the crankshaft (CPS) and camshaft position (CMP) sensors to control the sequence, dwell, and timing of the spark. The PCM 555 also monitors information from various sensor inputs that include, but are not limited to, the following:

- The throttle position (TP) sensor
- The engine coolant temperature (ECT) sensor
- The manifold air temperature (MAT) sensor
- The engine knock sensors (KS)
- The manifold absolute pressure (MAP) sensor

The PCM 555 contains eight ignition coil drivers (EST Outputs). They are used to control the ignition driver modules, located within each coil assembly. Signals are sent by the PCM 555 to each ignition coil to have the driver modules complete the ground path for the coil primary winding 12-volt power source. After the proper dwell time has been reached the PCM 555 signal is removed from the driver module and the ground path for the coil primary winding is opened – causing the ignition coil to fire the spark plug.

Main Power Relay (MPR)

The main power relay (MPR) is turned on by the PCM 555. Then the MPR sends 12-volt power from the 50-Amp Circuit Breaker to the ignition system fuse, and on to Pin "H" of the even and odd coil harness connectors.

Fuse

A 20-Amp fuse is used to protect the ignition system. The fuse is wired between the main power relay (MPR) and the odd coil and even coil harness connectors.

Crankshaft Position (CPS) Sensor

The crankshaft position (CPS) sensor is a three-wire Hall-Effect sensor. The sensor is located at the flywheel end of the engine block. It mounts into a step in the block, on the port side, to the rear of the port cylinder head. As the crankshaft reluctor wheel passes the sensor magnet the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The PCM 555 supplies a 5-volt and a low reference circuit to the CPS sensor. The sensor returns a digital ON/OFF pulse, 24 times per crankshaft revolution, to the PCM 555.

If the CPS pulses (signals) are not sent to the PCM 555 the engine will not run.

Crankshaft Reluctor Wheel

The crankshaft reluctor wheel is mounted on the rear of the crankshaft. The wheel is comprised of four 90 degree segments. Each segment represents a pair of cylinders at TDC. Each of these 90 degree segments is further divided into six 15 degree segments. Within each 15 degree segment is a notch of 1 of 2 different sizes. Each 90 degree segment has a unique pattern of notches. This is known as pulse width encoding. This pulse width encoded pattern allows the PCM to quickly recognize which pair of cylinders are at top dead center (TDC). The reluctor wheel is also a dual track, or mirror-image design. This means there is an additional wheel pressed against the first, with a gap of equal size to each notch of the mating wheel. When one sensing element of the CPS sensor is reading a notch, the other is reading a set of teeth. The resulting signals are then converted into a digital square wave output by the circuitry within the CPS sensor.

Camshaft Position (CMP) Sensor

The camshaft position sensor (CMP) sensor is also a Hall-Effect sensor, with the same type of circuits as the CPS sensor. This sensor is located in the front of the timing chain cover. It produces signals when the camshaft reluctor wheel rotates in front of the sensor tip. The CMP sensor signal is a digital ON/OFF pulse, output once per revolution of the camshaft. The CMP signal is compared with the CPS signal by the PCM 555. This allows the PCM 555 to know which one of each pair of pistons (1 and 6, 8 and 5, 7 and 4, or 2 and 3) is at TDC, on the compression stroke.

The loss of a CMP signal may result in a longer crank time since the PCM cannot determine which stroke the pistons are on.

Camshaft Reluctor Wheel

The camshaft reluctor wheel is part of the camshaft timing gear. The feature -or target- is read in an axial fashion. The reluctor wheel area (track) is the face of the camshaft timing sprocket. It is a smooth track, half of which is of a lower profile (grooved out) than the other half. This feature allows the CMP sensor to supply a signal as soon as the key is turned ON, since the CMP sensor reads the track profile, instead of a notch.

Ignition Coil Harness

The engine has two identical ignition coil harnesses. One supplies the even numbered coils (2, 4, 6 and 8) and the other one supplies the odd numbered coils (1, 3, 5 and 7). Each harness has seven connections:

- Pin "H" provides the 12-volt power for the ignition coils.
- Pin "A" is the ground circuit for the ignition coils.
- Pins "B," "C," "F" and "G" are the IC signal wires from the injector drivers in the PCM 555 controller. Each of these pins is connected to a separate ignition coil. The PCM 555 controls the sequence, dwell and timing of the spark. The PCM sends a signal to the coil driver module in each individual coil. The coil driver module turns the primary coil winding current ON and OFF.
- Pin "E" is the EST return path to the PCM 555 for the IC signals that are sent to the coils.

Ignition Coils

There is one ignition coil per cylinder. Each coil has a 12 volt power supply, 12 volt power ground path, EST signal wire (from PCM 555) and an EST signal return path (to the PCM 555). Each ignition coil contains a solid state driver module. The coil driver is normally closed. This allows the current to flow through the primary coil windings for the appropriate time (or dwell). When the PCM 555 commands the coil driver to open the primary winding circuit this will interrupt current flow through the primary coil windings. The magnetic field created by the primary coil windings will collapse across the secondary coil windings, which induces a high voltage across the spark plug electrodes. The coils are current limited to prevent overloading if the IC current is held high too long. The spark plugs are connected to their respective coils by a short secondary wire.

PCM 555 Ignition System Operation

The PCM 555 ignition system operates in the following manner.

- • When the ignition key is turned to the ON position, 12-volt power (wake-up power) is sent to the PCM 555.
- Then the PCM 555 grounds the main power relay (MPR) control circuit.
- Power from the 50-amp circuit breaker (mounted on the engine electrical bracket) passes through the MPR to a 20-Amp fuse and on to Pin "H" of the even coil (2, 4, 6 and 8) and odd coil (1, 3, 5 and 7) harness connectors. This provides the 12-volt power to the ignition coils.
- When the ignition key is turned to the start position the starter motor cranks the engine.
- The crankshaft position sensor (CPS) and the camshaft position sensor (CMP) create signals and send them to the PCM 555.
- The ignition coil driver module in each coil is normally closed and is providing a ground path for the current (that was sent to the coil from the 20-Amp fuse) to flow through the primary coil windings.
- The current flow creates a magnetic field that surrounds the primary and secondary coil windings. The period of time that the current is allowed to flow through this circuit is referred to as dwell.
- When the required dwell period has been completed the PCM 555 commands the coil driver module to open the primary winding ground path circuit. This will interrupt current flow through the primary coil windings. (Note: The PCM 555 adjusts the dwell by look-up maps in the PCM 555 logic that are based on the energy required for the speed/load point at which the engine is running.)
- The magnetic field, created by the current flowing through the primary coil windings, will collapse across the secondary coil windings. This induces a high voltage in the secondary windings that is sent from the coil to the high tension lead and on to the spark plug. This cycle is repeated for the firing of each individual ignition coil and spark plug in the engine.

PCM 555 Diagnostics

A fault indicates that the PCM 555 has either sensed that the circuit in question has recorded a sensor value outside of its acceptable window or that a sensor value has gone outside its normal range. For example:

1. A circuit with an open or short gives a fault that is "CKT HI" or "CKT LO." This means that the sensor itself has failed with an open or short circuit, or one of the leads between the sensor and the PCM is open or shorted. A "CKT HI" fault means that the PCM is seeing a 5.0 (or nearly 5) volt signal and a "CKT LO" fault means that the PCM is seeing a 0.0 (or nearly 0) volt signal.
2. A sensor showing a reading outside of its normal range, but not shorted or open, would give a fault identifying an abnormal operating condition, such as ECT Coolant Overheat, which means the ECT circuit is operating correctly, but the engine is simply overheating.

Abbreviated Procedure:

1. The process begins with a customer complaint or when the technician notes an observable symptom.
2. The technician must verify (or duplicate) the complaint (or symptom).
3. The technician should connect a CDS tool and check for faults.
    a. If the fault is a CKT HI or CKT LO, refer to the wiring diagram and check each of the leads between the suspect sensor and the PCM for open and short circuits. The short circuit does not have to be to ground, it could be to any other wire in the harness. If the leads test good, then the sensor should be replaced.
        i. When troubleshooting active faults (faults displayed under the "Fault Status" screen), the circuit in question is experiencing a failure right now. Look for an open circuit or short circuit in the two or three wires involved with the sensor in question, the sensor itself has actually failed or the connections at the PCM have failed.
        ii. When troubleshooting intermittent faults (faults displayed under the Fault History screens or faults that are NOT active in the Fault Status" screen), the circuit in question is not experiencing a failure at this time. Look for an intermittent connection or an intermittent short circuit that is not present right now. You must still check circuits for opens and shorts, but you must wiggle wires and connectors during all tests in attempt to locate the poor connection. Carefully look for subtle problems, such as corroded connections and internal wiring harness splices; and for connectors with a loose fit between the male and female pins.
        i. Use the data monitor function of the CDS tool to find an intermittent problem. While observing the data from the suspect circuit, wiggle the wires and connectors of the suspect circuit while the key is on or while the engine is running. When you locate the bad connection or broken or shorted lead, the data reading will fluctuate on the scan tool. Keep in mind that the refresh rate of the scan tool is relatively slow (every 50 milliseconds or so).
        ii. The record (or min/max) function of the DMT 2000 (or equivalent) multimeter can also be used to monitor and record the voltage signals on the suspect circuit. Use the Rinda 94025 Jumper Lead Set (or equivalent) to connect the meter to the suspect sensor’s signal lead. Sensor signals must never be 0.0 or 5.0 volts. A multimeter can catch glitches in as little as a microsecond.
    b. If the fault is an abnormal operating condition, repair the system as needed. For example, if the sea pump pressure is low, check the water pickups for obstructions, then replace the water pump impeller and other parts as needed. Abnormal operating condition faults can be active or intermittent.

c. Faults rarely indicate a defective PCM/ECM. Assume that the PCM is working correctly until complete and thorough troubleshooting procedures prove otherwise.

4. If no faults are present, but you still have an observable symptom, then the problem is with a component or system that the PCM cannot monitor. Carefully perform the **Visual and Physical** check (in the following section) and check for obvious problems, such as incorrect fuel pressure, engine mechanical problems, exhaust blockage, etc.
   a. The problem may be that a sensor is out of calibration or it may be that the problem has nothing to do with the EFI system (clogged fuel supply system, mechanical engine problems, etc.).
   b. You can use the scan tool to fire the ignition coil or coils with or without the spark plugs installed. You can also use the scan tool to drop cylinders (while running) to do power balance tests. On PCM models, each cylinder's injector can be dropped individually. On ECM models, each injector bank can be dropped individually.
5. If there are no faults and no observable symptoms, then troubleshooting is finished.

Visual and Physical Check:

1. Verify that the battery is fully charged and is of sufficient capacity for the engine being tested. If necessary, substitute a known good battery.
2. Check the battery cable connections. Make sure they are clean and tight. If present, discard wing nuts and replace with corrosion-resistant hex nuts. A corrosion-resistant toothed washer should be installed between the battery terminal and the cable end (stack up must be battery terminal, washer, cable, nut). Make sure the cable connections are tight at the starter solenoid and that the block fuse on the starter solenoid (if present) is tight and its through bolt is not loose. Also make sure the ground stud is not loose in the engine block and that its nut is tight.
3. If there is any doubt about the mechanical condition of the engine, perform a compression test and a cylinder leak-down test.
4. Make sure the safety lanyard is correctly installed and that the customer understands the correct starting procedure.
5. Check that all grounds are clean and tight. If the negative battery cable is connected to the ground stud that does not contain all of the EFI and engine wiring harness ground leads, consider moving the negative battery cable to that ground stud.

⚠ WARNING

Performing tests with the engine running may cause the propeller to rotate and result in serious injury or death. Use caution when performing a test that requires the engine running, and remove the propeller to avoid injury.

6. Unplug and inspect the main harness (10-pin or 14-pin) connector between the engine and boat harnesses. If there is any doubt about the boat harness, substitute a shop harness and key switch assembly and rerun the boat. If the problem disappears, the problem is in the boat harness, not the MerCruiser engine harness. A suitable non-DTS test harness can be assembled from the following components:
   a. MerCruiser 3-foot instrument harness cable for 10-pin engines, or
   b. MerCruiser 2-foot instrument harness cable for 14-pin engines

NOTE: *The red/yellow wires for the neutral safety switch on this harness must be tied together to crank the engine and perform this test.*

   c. MerCruiser ignition switch assembly

d. Use suitable machine screws and nuts to join the switch ring terminals to the harness's ring terminals, then cover the connections with heat shrink tubing.

e. A standard piezo warning horn can also be added to provide audible warning of cooling system overheat, low crankcase oil pressure and low drive oil level or high transmission temperature.

7. Check for adequate fuel pressure at the fuel rail.

   a. If there is no fuel pressure, check that the fuel pump is actually operating. The pump must run for at least 2 seconds each time the key is turned to the on position. If the fuel pump(s) and the warning horn are not operating as the key is turned on, make sure the PCM is powering up (check the fuses and the wake-up line).

   b. On PCM models, fuel pressure varies with engine vacuum. Fuel pressure will be high during cranking, low at idle and increase proportionally as the throttle is opened to the wide-open position. Disconnect the vacuum line (on the Cool Fuel regulator) to find the regulator's rated pressure, then reconnect the vacuum line to make sure the pressure drops at idle. Pressure specification is 43 psi (+/– 2 psi) on all models. Pressure usually drops about 6–8 psi at idle (from the regulator's rated specification).

   c. If fuel pressure drops at higher speed and higher engine loads, check the boat's fuel system (the supply system) for restrictions with an accurate vacuum gauge and clear hose at the water separating fuel filter's inlet. As the engine is run from idle to wide-open throttle and back to idle, the clear hose must not show the presence of any air bubbles and the vacuum gauge must not read higher than 2 in.hg. Refer to Service Bulletin 99-7 for additional information.

   d. If the supply system tests OK, but the fuel pressure is low at high speeds and loads, replace the water separating fuel filter and retest. If pressure is still low, most likely the fuel pump is defective

   e. All PCM models use a dummy fuel pressure regulator on the fuel rail. This is not used on marine applications (but is a GM supplied part). The vacuum line attached to the dummy regulator is a possible vacuum leak and a possible fuel leak (if the dummy regulator's diaphragm should fail). Only the Cool Fuel regulator actually controls fuel rail pressure.

8. Check all vacuum lines for splits, kinks, and proper connections. The fuel regulator on all PCM models must be connected to manifold vacuum. The PCV valve is a calibrated air leak; if it is missing or the incorrect valve is installed, engine operation will be effected.

9. Check for any other additional air leaks in the induction system, such as throttle body and intake manifold gaskets. If the normal IAC % for the engine are known, then any air leak will result in a lower IAC % than normal.

10. Unplug and inspect the PCM A, B and C connectors. Make sure there are no PCM pins bent over and that all of the correct pins are present. Refer to the service manual charts for the pins used and not used. Look for signs of tampering, corrosion, damage to the pin locking mechanisms, melted insulation, and any other evidence of shorts or other damage.

11. Unplug and inspect as many of the sensors and actuators as you can reasonably access. Look for signs of tampering, corrosion, damage to the pin locking mechanisms, melted insulation, and any other evidence of shorts or other damage. Based on the results of this inspection, further inspection of the harness may be necessary. Remember that there are many internal splices in the harness that may be damaged or defective. If there is damage on the external connections, inspect several of the internal splices to verify that the damage is not also present at these locations.

12. Check for adequate secondary spark. If an air gap tester is used, make sure it will not ignite any fuel vapors that may be present in the bilge. A KV meter can also be used to check for adequate secondary voltage. Make sure the secondary wires are in good physical condition (correctly routed and that the boots are not split at either end). Remove the distributor cap and check for signs of moisture and carbon tracking.

Clearing Codes:

Faults are cleared with a scan tool only. Refer to the appropriate CDS flow chart in the PCM Technician Guide for appropriate menus.

1. When firing the ignition coil(s) under the "Auto Self Test" and "Output Load Test" screens:
   a. You must specify if the spark plugs are installed or not. If the spark plugs are installed, the PCM will fire the coil at the minimum dwell time to prevent it from actually sparking in the combustion chamber (possibly igniting fuel vapors). If the spark plugs are not installed, the PCM will fire the coil(s) at the maximum dwell time to allow for visible spark. In either case, the PCM will monitor the 5-volt trigger circuits to attempt to detect whether the coil has fired.

NOTE: *Using an air gap tester instead of a resistor-type spark plug may cause RFI that can result in the warning horn chirping or other unusual symptoms to occur. DO NOT allow open spark to occur if fuel vapors might be present.*

   b. A PCM can individually fire each coil. However, the spark will attempt to go to wherever the rotor in the distributor is pointing. You must test at the coil lead or know where the rotor is pointing and install the test spark plug in that cylinder's lead.
2. When performing the "Cylinder Misfire Test," the PCM will add extra fuel through the fuel injectors at idle and off-idle speeds, but will turn off the fuel injectors at higher speeds. The test is best performed under high-load, high-speed conditions. A PCM can individually control each fuel injector. The 5.0L, 5.7L, and 6.2L V-8 engines equipped with DTS and a PCM 555 processor will have four injector selections available on the Active Test screen in the Toolbox. These newer engines have 4 injector drivers to fire the injectors in pairs.
3. When firing the fuel injectors under the "Auto Self Test" and "Output Load Test" screens, the same rules apply as above. PCM fires individual injectors, ECM fires banks.

IMPORTANT: On PCM555 engines, when the crankshaft is exactly at #1 TDC compression, the HVS distributor's rotor must exactly align with the #8 (V8 engines) cast into the distributor housing. If not, the spark will jump to the wrong "tower" in the distributor cap.

4. Timing is not adjustable on any PCM engine. Rotating the HVS distributor from its properly indexed position will cause the spark to jump to the wrong tower in the HVS distributor cap.

DTS Faults

Faults relating to the ERC (electronic remote control) are displayed on the System View (SC5000) or CDS. There are three potentiometers in an ERC, one for shift control and two for throttle control, as well as switches for trim control, system view cursor control, and other features.

Faults relating to the ETC (electronic throttle control) and the ESC (electronic shift control) are displayed on the DDT, the System View, and CDS.

Two TPS sensors are integrated into the ETC. The ETC is replaced as an assembly and is not serviceable. There are six wires on an ETC: Sensor power, sensor ground, TP1 signal, TP2 signal and two wires to run the servo motor.

The ESC contains one integrated sensor (like a TPS). The ESC is replaced as an assembly and is not serviceable. There are five wires on an ESC: Sensor power, sensor ground, sensor signal and 2 wires to run the servo motor. A separate 2-wire neutral switch is used to cross-check the integrated sensor. The switch is located on the shift bracket (Bravo models) and is the transmission's neutral safety switch on inboard models.

DTS engines use a different PCM 555 controller with a Motorola base part number of 859611.

Propulsion Control Module (PCM) and Sensors

General Description

The Mercury MerCruiser Electronic Fuel Injection system is equipped with a computer that provides the engine with state-of-the-art control of fuel and spark delivery. Computers use voltage to send and receive information.

Computers and Voltage Signals

Voltage is electrical pressure, but voltage does not flow in circuits. Instead, voltage causes current flow. Current does the real work in electrical circuits. Current, the flow of electrically charged particles, energizes solenoids, closes relays, and lights lamps.

Besides causing currents in circuits, voltage can be used as a signal. Voltage signals can send information by changing levels, changing waveform (shape), or changing the speed at which the signal switches from one level to another. Computers use voltage signals to communicate with one another. The different sections inside computers also use voltage signals to communicate with each other.

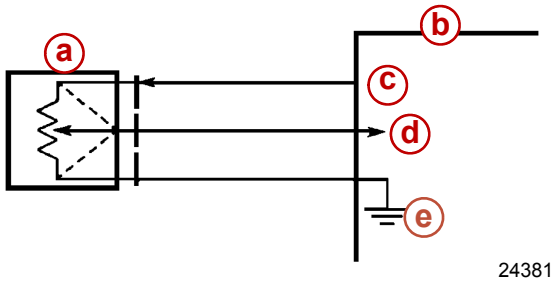
There are two kinds of voltage signals:analog and digital. Both of these are used in computer systems. It's important to understand the difference between them and the different ways they are used.

Analog Signals

An analog signal is continuously variable. This means that the signal can be any voltage within a certain range. An analog signal usually gives information about a condition that changes continuously over a certain range. For example, in a marine engine, temperature is usually provided by an analog signal. There are two general types of sensors that produce analog signals: the 3-wire and the 2-wire sensor.

THREE-WIRE SENSORS

The following figure shows a schematic representation of a three-wire sensor. All three-wire sensors have a reference voltage, a ground and a variable wiper. The lead coming off of the wiper will be the signal to the Propulsion Control Module (PCM). As this wiper position changes, the signal voltage returned to the computer also changes.

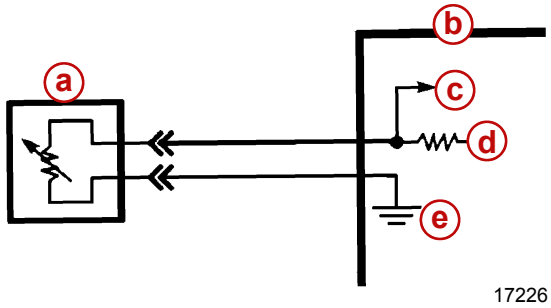


3-Wire Sensor

a - Typical Sensor
b - PCM
c - Voltage Out
d - Signal Input
e - Sensor Ground

TWO-WIRE SENSOR

The following figure is the schematic of a two-wire–type sensor. This sensor is basically a variable resistor in series with a fixed-known resistor within the computer. By knowing the values of the input voltage and the voltage drop across the known resistor, the value of the variable resistor can be determined. The variable resistors that are commonly used are called thermistors. A thermistor's resistance varies inversely with temperature.

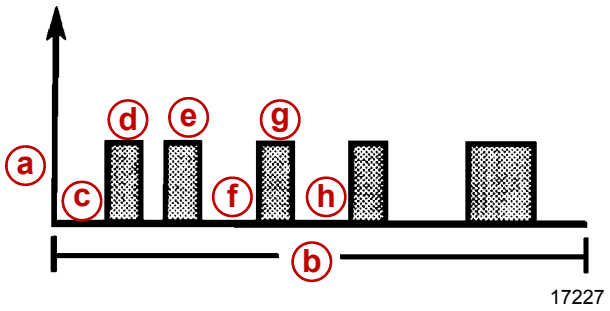


2-Wire Sensor

a - Typical Sensor
b - PCM
c - 5 Volt
d - Signal Sensor
e - Sensor Ground

Digital Signals

Digital signals are also variable, but not continuously. They can only be represented by distinct voltages within a range. For example, a digital signal might contain distinct voltage values of 1 V, 2 V or 3 V, but vin between, such as 1.27 V or 2.65 V would not not typically be found. Digital signals are especially useful when the information can only refer to two conditions: yes and no, on and off, or HIGH and LOW. This is called a digital binary signal. A digital binary signal is limited to two voltage levels. One level is a positive voltage, the other is no voltage (zero volts). As you can see in the following figure, a digital binary signal is a square wave.



Digital Binary Signal

a - Voltage
b - Time
c - Lo
d - Hi
e - On
f - Off
g - Yes
h - No

The computer uses digital signals in a code that contains only ones and zeros. The high voltage of the digital signal represents a one (1), and no voltage represents a zero (0). Each zero and each one is called a bit of information, or just a bit. Eight bits together are called a word. A word, therefore, contains some combination of eight binary code bits: eight ones, eight zeros, five ones and three zeros, and so on.

Binary code is used inside a computer and between a computer and any electronic device that understands the code. By stringing together thousands of bits, computers can communicate and store an infinite variety of information. To a computer that understands binary, 11001011 might mean that it should reset engine RPM at a lower level. Although the computer uses 8-bit digital codes internally and when talking to another computer, each bit can have a meaning.

SWITCH TYPES

Switched inputs (also known as discretes) to the computer can cause one bit to change, resulting in information being communicated to the computer. Switched inputs can come in two types: they are pull-up and pull-down types. Both types will be discussed.

With a pull-up type switch, the ECM will sense a voltage when the switch is closed. With the pull-down switch, the ECM recognizes the voltage when the switch is open.

Discretes can also be used to inform a computer of frequency information.

PULSE COUNTERS

For the computer to determine frequency information from a switched input, the computer must measure the time between voltage pulses. As a number of pulses are recorded in a set amount of time, the computer can calculate the frequency. The meaning of the frequency number can have any number of meanings to the computer.

An example of a pulse counter type of input is the distributor reference pulse input. The computer can count a train of pulses, a given number of pulses per engine revolution, and determine the rpm of the engine.

Propulsion Control Module (PCM)

The Propulsion Control Module (PCM) is the control center of the fuel injection system. It constantly monitors information from various sensors, and controls the systems that affect engine performance.

The PCM also performs a diagnostic function check of the system. It can recognize operational problems and store a code or codes which identify the problem areas to aid the technician in making repairs.

PCM FUNCTION

The PCM supplies 5 or 12 volts to power various sensors or switches. This is done through resistances in the PCM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, the use of a 10 megΩ input impedance digital voltmeter is required to assure accurate voltage readings.

Engine Guardian System

General Description

Engine Guardian is the focal point of the self-diagnostic strategy on these engines. It helps protect the engine from possible damage that could result from several faulty conditions. The system monitors the sensors incorporated on the engine and, if a malfunction is discovered, the system stores a fault description in the ECM/PCM and available power may be reduced. By ensuring that engine output is at a low enough level, the engine is better protected from mechanical failures.

For example, if an open or short is found in any sensor, available power is reduced to 90% of total, the audio warning system alarm will sound 2 beeps per minute (2 Bp/min) and the SmartCraft gauges will display a warning lamp. In a seawater pump pressure low condition, the maximum RPM will vary with the pressure and temperature of the engine and could be limited to idle in extreme cases of overheating, a constant beep will sound and SmartCraft gauges will display a warning lamp.

IMPORTANT: Engine Guardian cannot guarantee that engine damage will not occur when adverse operating conditions are encountered. Engine Guardian is designed to warn the operator of an adverse condition and to reduce power by limiting RPM in an attempt to reduce possible engine damage. The boat operator is ultimately responsible for proper engine operation.

Audio Warning System

A power package controlled by a PCM may be equipped with an audio warning system. The audio warning system is designed to warn the operator that a malfunction has occurred and will not protect the engine from damage.

The audio warning (horn output) will sound if the PCM detects a malfunction.

NOTICE
A continuous horn indicates a critical fault. Operating the engine during a critical fault can damage components. If the warning horn emits a continuous beep, do not operate the engine unless avoiding a hazardous situation.

All Serial Numbers 0M000000 and Above

Models	**All Serial Numbers 0M000000 and Up**	496 MAG BRAVO	
		496 MAG HO BRAVO (PCM 555)	
Horn Output	**Possible Cause**	**Corrective Action**	**Engine Usage Available For Consumer**
Single beep at start up	Normal test horn	No Action Required	No action required
Two beeps every minute	Sensors	Connect CDS to determine and diagnose the problem	Possible 90% available power (dependent on sensor). See dealer for diagnostics.
	Open-short in circuits		
Intermittent continuous beeps	Drive lube bottle	Check drive lube bottle for oil and possible malfunction with switch	If drive reservoir is full, see dealer for diagnostics.
Continuous horn	Battery voltage	Connect CDS to determine and diagnose the problem	5–90% available power dependent on actual fault. Guardian is active!
	Guardian strategy		
	Over speed		
	ECT overheat		
	ECM memory		
	Multiple CAN Circuit faults		
	EMCT overheat		
	Engine oil pressure	Stop engine immediately, check the oil level	Run engine only in emergency. Forced idle RPM only

All Serial Numbers 0M000000 and Above

Models	**All Serial Numbers 0M000000 and Up**	8.1S Horizon	
		8.1S HO Inboard (PCM 555)	
Horn Output	**Possible Cause**	**Corrective Action**	**Engine Usage Available For Consumer**
Single beep at start up	Normal test horn	No Action Required	No action required
Two beeps every minute	Sensors	Connect CDS to determine and diagnose the problem	Possible 90% available power (dependent on sensor). See dealer for diagnostics.
	Open-short in circuits		
Intermittent continuous beeps	Transmission overheat	Stop engine and check transmission fluid level. Look for a possible restriction in the cooler.	No power loss. If fluid level is acceptable, have the dealer inspect cooler/transmission switch. If transmission has overheated, perform a transmission flush and replace fluid.
Continuous horn	Battery voltage	Connect CDS to determine and diagnose the problem	5–90% available power dependent on actual fault. Guardian is active!
	Guardian strategy		
	Over speed		
	ECT overheat		
	ECM memory		
	Multiple CAN Circuit faults		
	Engine oil pressure	Stop engine immediately, check the oil level	Run engine only in emergency. Forced idle RPM only

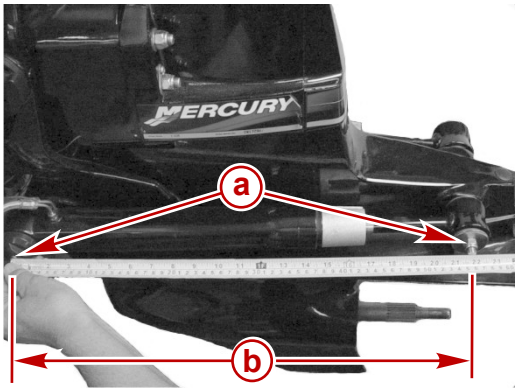
All Digital Throttle and Shift (DTS) Sterndrive and Inboard Engines

Models	All Digital Throttle and Shift (DTS) Sterndrive and Inboard Engines		
Horn Output	**Possible Cause**	**Corrective Action**	**Engine Usage Available for Consumer**
Single beep at start up	Normal test horn	No Action Required	No action required
Two beeps every minute	Sensors	Connect CDS to determine and diagnose the problem	Possible 90% available power (dependent on sensor). See dealer for diagnostics
	Open-short in circuits		
Intermittent continuous beeps	Transmission overheat	Stop engine to check fluid level	No power loss. If fluid level is okay, have dealer inspect cooler/transmission temperature switch. If transmission has over heated flush and replace fluid.
	Drive Lube bottle		
Continuous horn	Battery voltage	Connect CDS to determine and diagnose problem	5–90% available power dependent on actual fault. Guardian is active!
	Guardian strategy		
	Over speed		
	ECT overheat		
	ECM memory		
	Multiple CAN circuit faults		
	EMCT overheat		
	DTS Sensor Failure		5% Available Power
	Engine oil pressure	Stop engine immediately, check oil level.	Run engine only in emergency! Forced idle RPM only.

Setting the Trim Limit on 496 Mechanical Engines (with 3-wire SmartCraft sender)

The following steps must be followed to set the trim limit on 496 mechanical engines (10-pin harness and 14 pin [mechanical] harness models) with a 3-wire SmartCraft trim sender.

1. Trim the drive unit to the full, down-in position until the trim pump stalls.
2. Trim the drive up at helm until the measurement between the centers of the anchor pins on the trim cylinders is 55.24 cm (21-¾ in.).

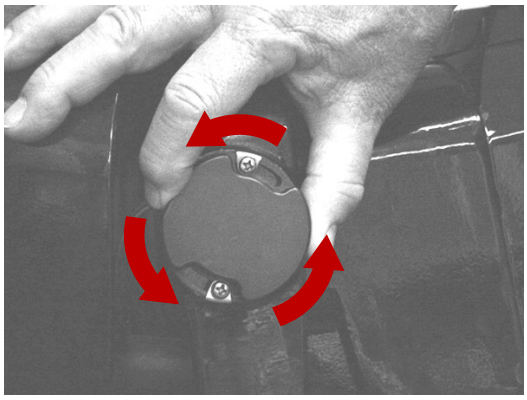


Trimmed up to measurement

a - Anchor pin **b -** Measurement

3. Loosen the two retaining screws on the port trim limit 3-wire sender.

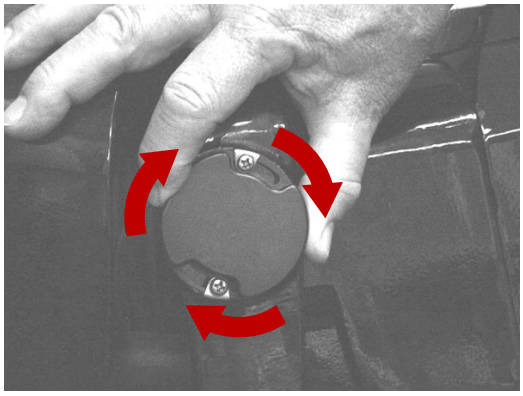
4. Rotate the sender **counterclockwise** until a click sound can be heard from the trim relay. Stop rotating the sender.



31003

Rotating the port trim limit sender counterclockwise

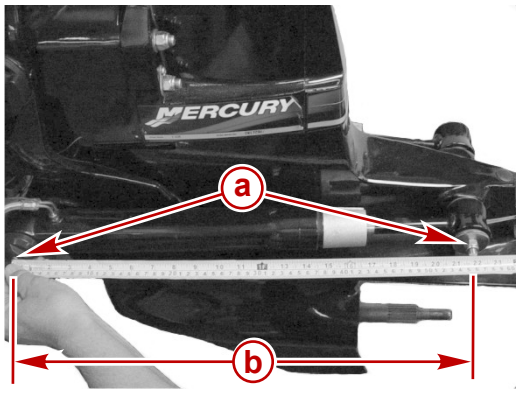
5. Rotate the port trim limit sender **clockwise** until a click sound can be heard from the trim relay. Stop rotating the sender.



31004

Rotating the port trim limit sender clockwise

6. Tighten the two retaining screws.
7. Trim the drive unit to the full, down-in position and then to the full, up-out position.
8. Measure between the centers of the anchor pins on the trim cylinder. The measurement should be 55.24 cm (21-¾ in.)or less. If the measurement is greater than specified, further adjustment to the port trim limit 3-wire sender is required.



30997

Measurement after adjustment

a - Anchor pin **b -** Measurement

Setting Trailer and Trim Position on MerCruiser DTS Engines

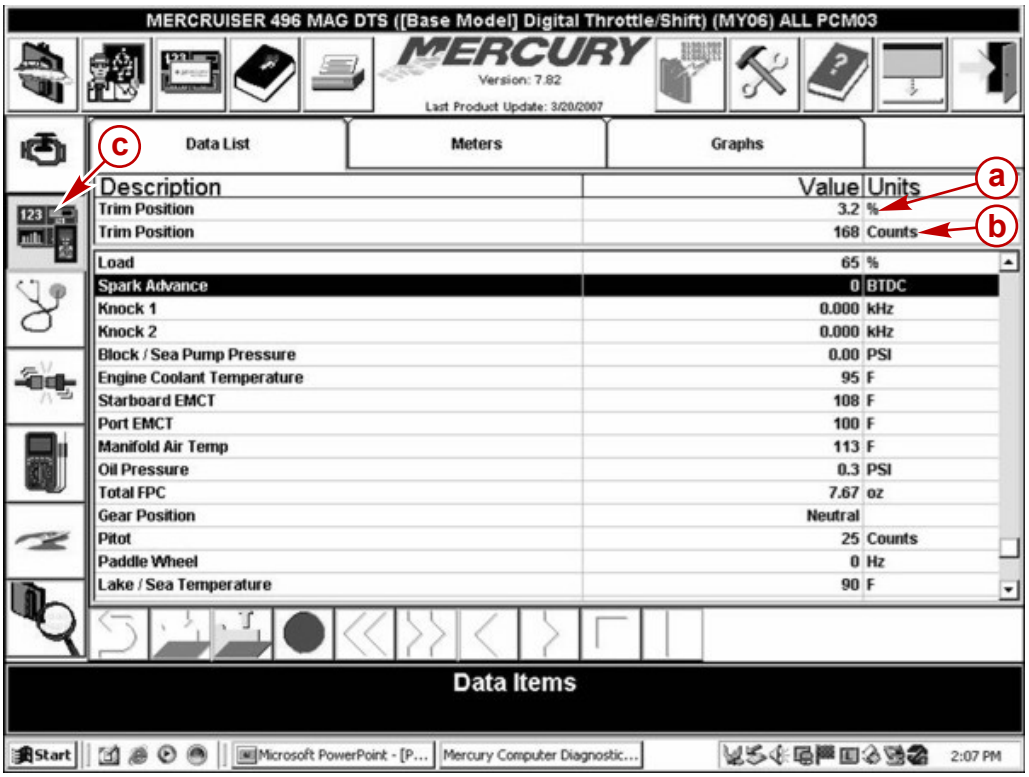
IMPORTANT: If the PCM is re-flashed or replaced for any reason, trailer and trim positions must be reset. Follow the steps below for initial set up.

NOTE: *Do not to make contact with the swim platform while trimming up to the trailer position. One person should be positioned at the rear of the boat to make sure the sterndrive will not contact the swim platform while running this test, since no limits have yet been set.*

1. Before connecting the CDS tool trim the sterndrive one complete cycle. Turn the key switch on and trim the sterndrive to the full, up-out trailer position and then, the full down-in position. Once this cycle has been completed, turn the key off and move the ERC levers to Reverse WOT. Proceed with the set up.
2. Connect the CDS tool to the Engine Diagnostic connector.
3. Turn the key switch on.
4. Select the appropriate engine set up on the CDS.
5. Select the "Tool Box" icon and then the Data Items icon. The data items screen should appear..

NOTE: *Trailer limit must be set before trim limit*

6. Select Trim position in (%) and Trim position in counts as shown on next screen.

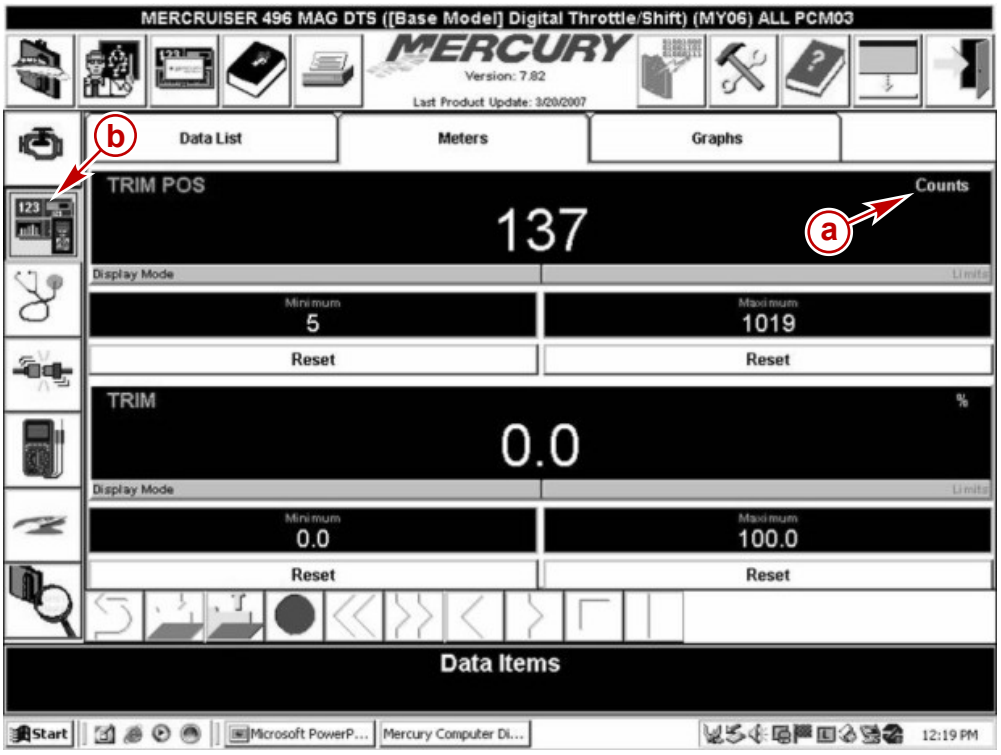


30978

a - Percent row
b - Counts row
c - Data Items icon selected

7. Trim the drive to full down position and stall the pump for 3 seconds. Look at the trim counts row. In the full down position the counts should be as shown in the applicable screen capture.

NOTE: *The number of Bravo One and Two counts are slightly less than Bravo Three counts due to the different positions of the trim-in limit pin inserts on the rear anchor pin.*

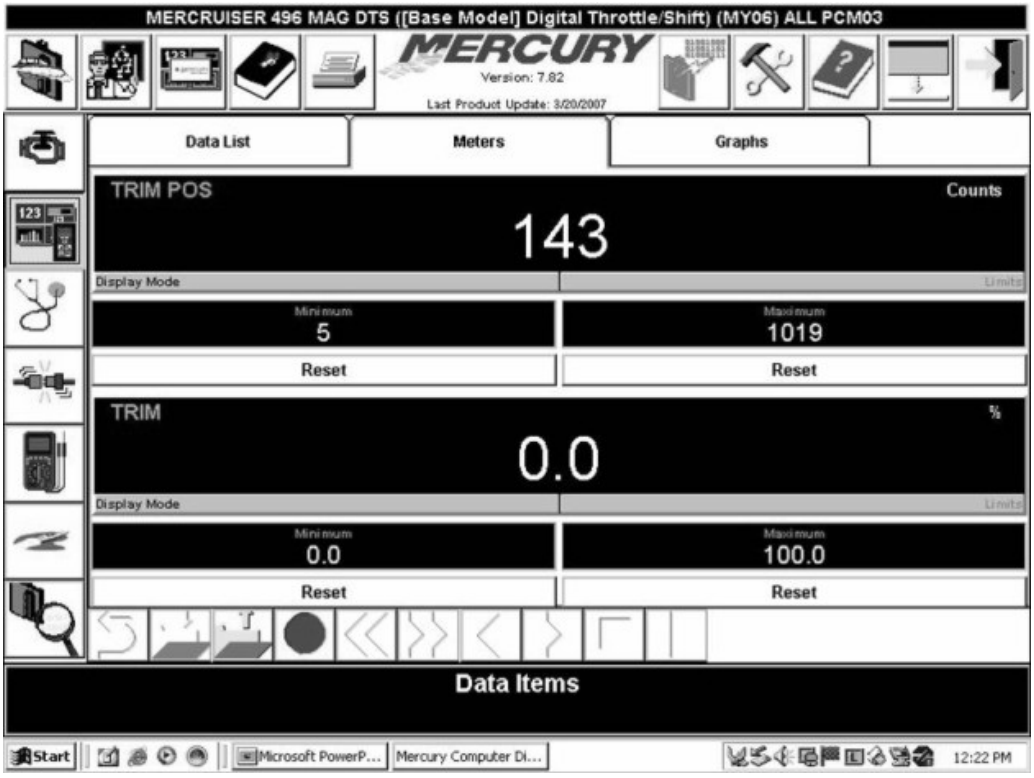


30986

Bravo One and Two counts—full down position

a - Counts row

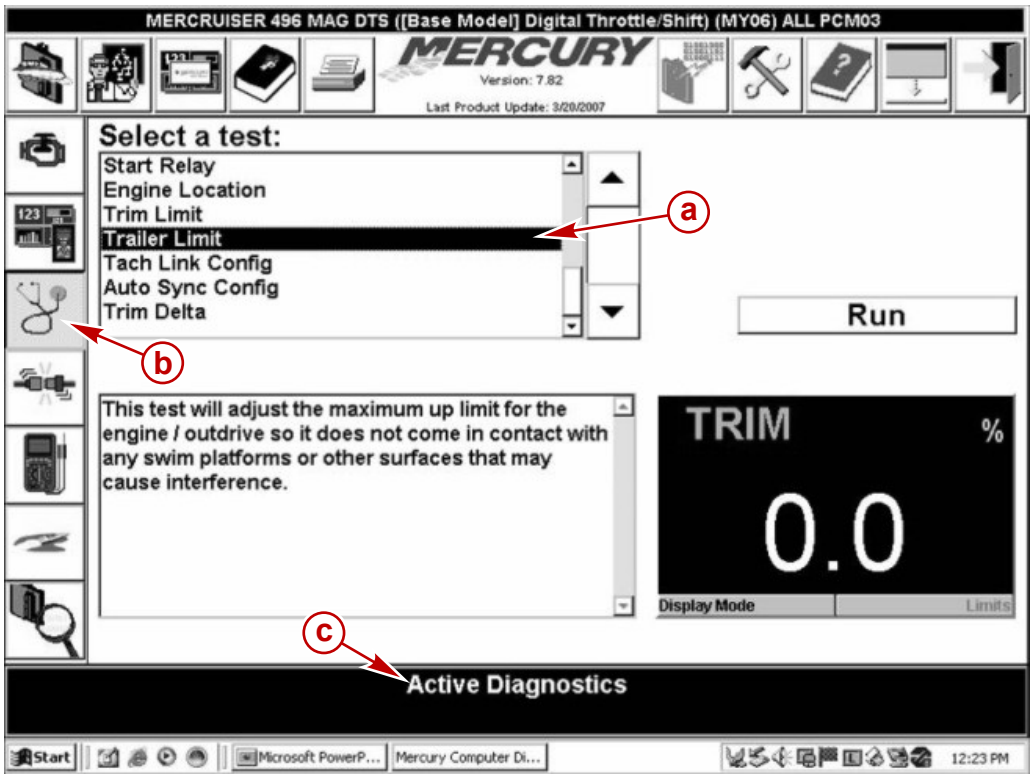
b - Data Items selected



30987

Bravo Three counts—full down position

8. Verify the counts are as indicated for the sterndrive model you are testing. Adjust if necessary.
9. Select the Active Diagnostics icon to set the trailer limit.

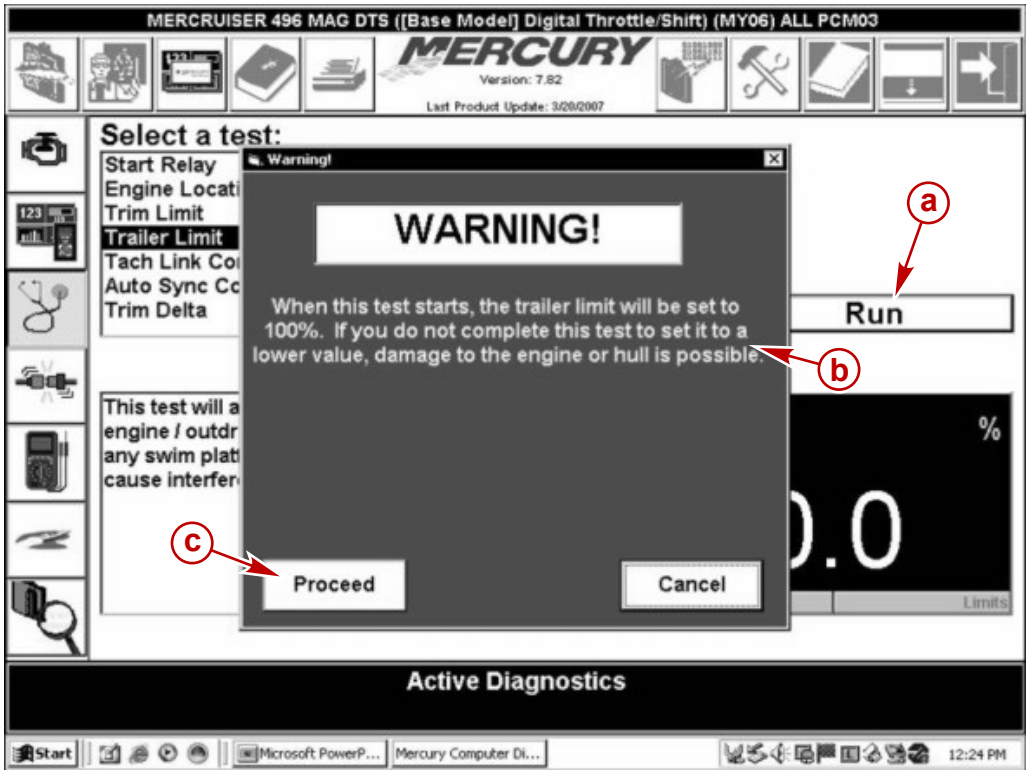


30988

a - Trailer limit function selected
b - Active Diagnostic icon selected
c - Screen confirmation

10. Click on the Run button. A red dialog box will appear with a warning statement. Read and observe the warning statement.

11. Click on the Proceed button to continue.

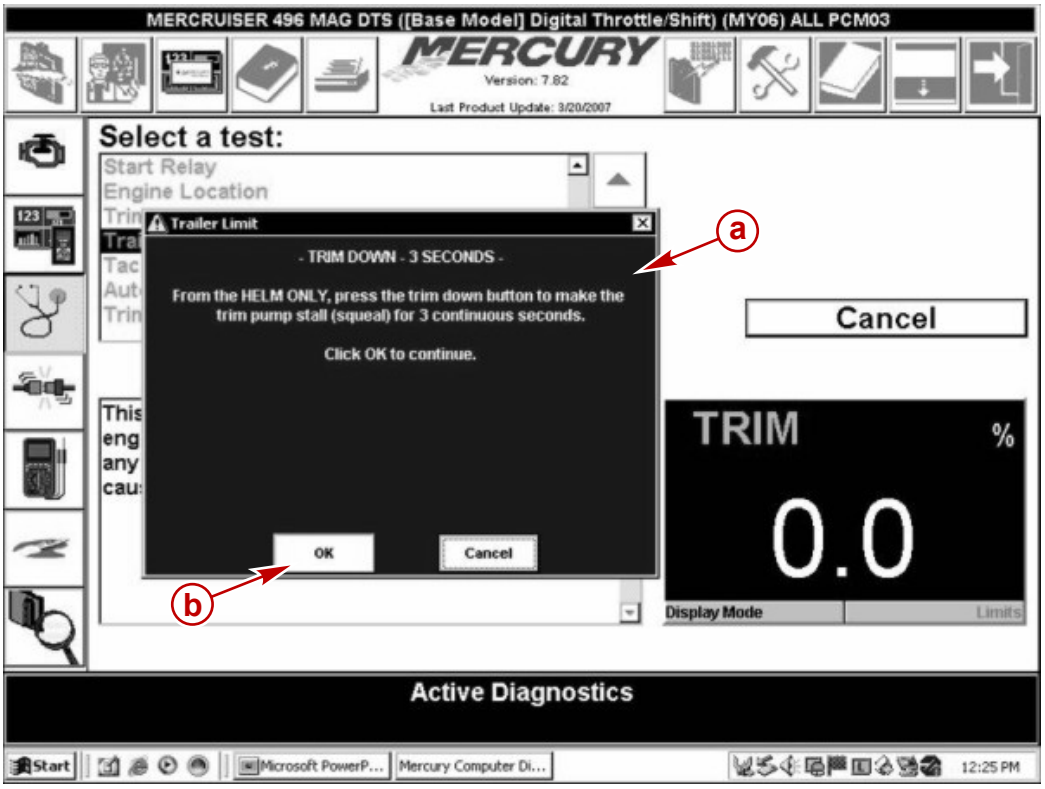


30989

a - Run button
b - Warning statement
c - Proceed button

12. Once you click the Proceed button in the red dialog box, a blue dialog box will appear giving new instructions.
13. Working **only from the helm**, press the trim down button until the trim pump stalls (squeals) for 3 continuous seconds.

14. Discontinue pressing the trim down button, and click on the OK button to continue.

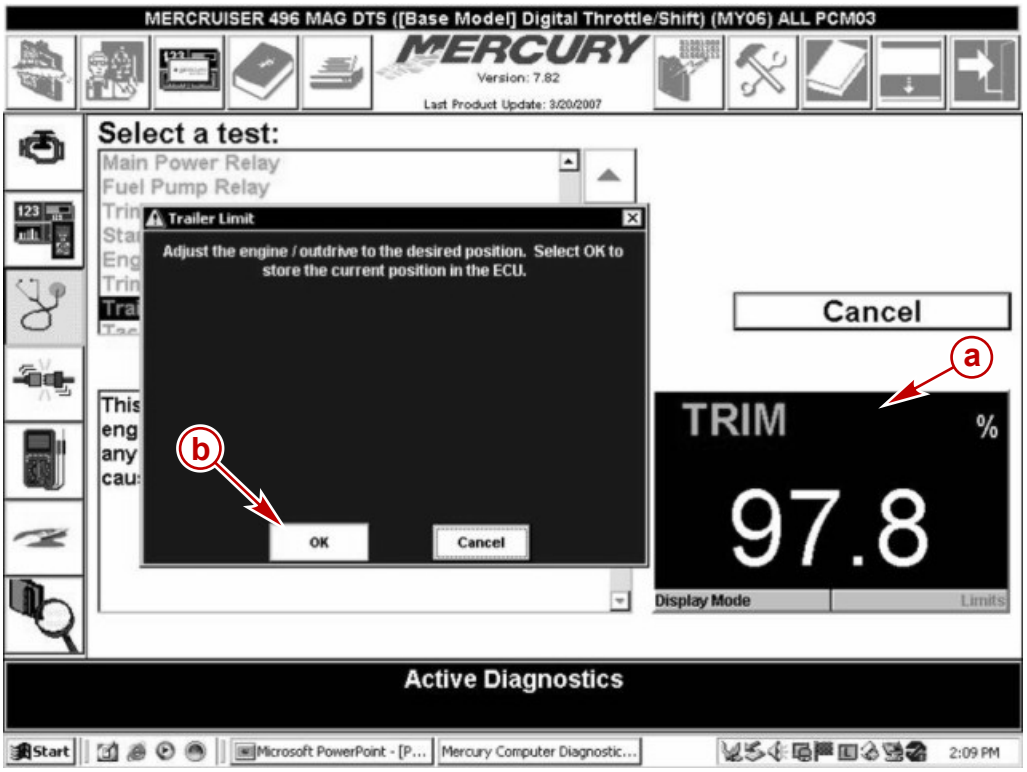


30990

a - Blue dialog box
b - OK button

15. Working **only from the helm**, press the trim down button until the trim pump stalls (squeals) for 3 continuous seconds.
16. Working **only from the helm**, press and hold the trailer button until the drive is full up or before contact with the swim platform or other obstruction.
17. Click the OK button to store the position the PCM.

NOTE: *Notice the trim position percent may not be at 100 percent. The percent amount shown in the percent dialog box will vary due to the different positions of the trim-in limit pin inserts on the rear anchor pin.*

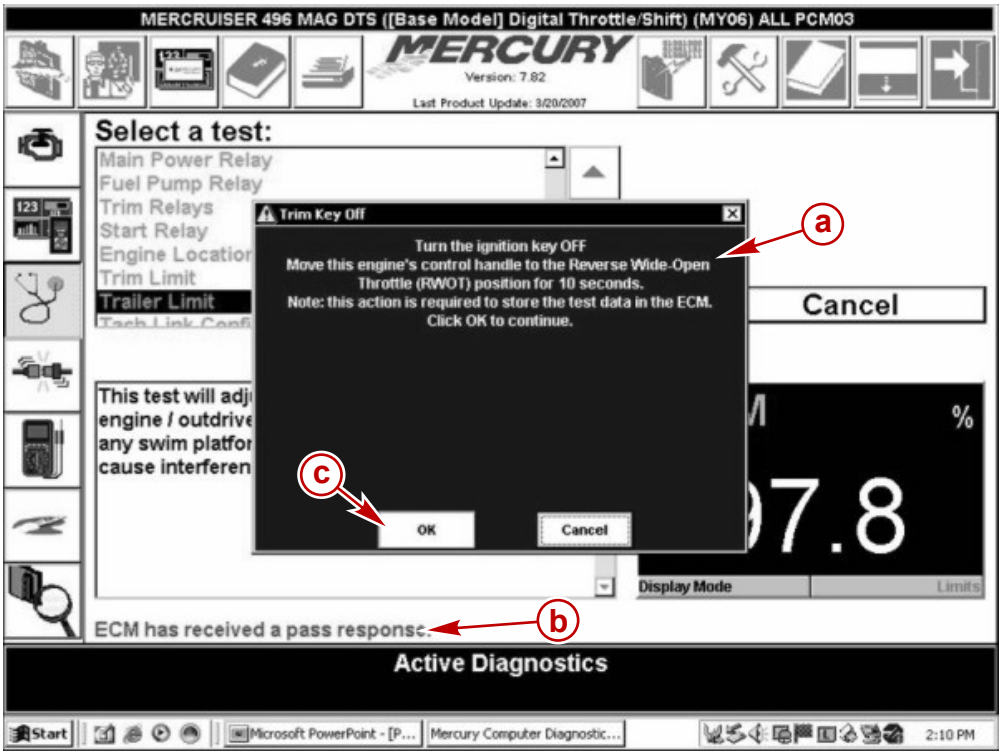


30991

a - Percent dialog box
b - OK button

18. Once you click the OK button in the blue dialog box, another blue dialog box will appear giving new instructions.
19. Turn the ignition key off.
20. Move the ERC levers to the reverse WOT position for 10 seconds. This step is required to store the data in the PCM.

21. After the notice with red text appears near the bottom of the CDS screen stating that the response was received, click the OK button.



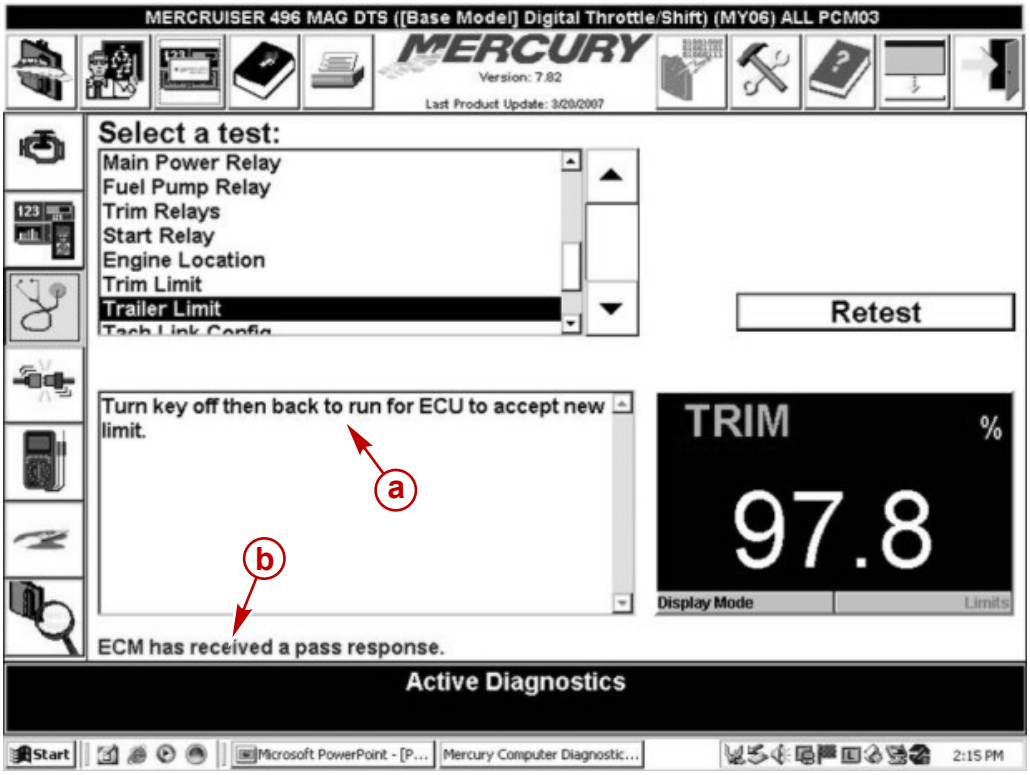
30992

a - Blue dialog box
b - Notice in red text
c - OK button

NOTE: *On MY 2006 and above DTS models, disregard the dialog box instructions to turn the key off and then back to run. Those instructions apply to earlier DTS models. Turn the key switch on or off only as instructed in these steps.*

22. The change in the notice from red text to blue text indicates that the setting has been accepted and stored in the PCM.
23. If you need to reset the trailer position or the PCM failed to accept the trailer limit setting do the following:
    a. Go back to the Active Diagnostics and go to the trailer test.
    b. Start the test for Trailer Limit.
    c. When you click on Tun Test , the red window will appear, click proceed. The blue window will then appear. Stall the pump in the down position for three seconds.
    d. Click "OK" and another blue window will appear telling you to trailer the drive to the desired position. At this time you will use a remote switch on the trim pump to position the drive all the way to maximum trailer position. Once achieved, go to the helm trim button and push up for 3 seconds. The pump will not run at this time.
    e. Click "OK" and another blue window will appear stating: "Turn ignition key to the off position and take control handle to RWOT." Then, click "OK".
    f. At this time the you should have received a passing response in blue at the bottom of the screen, indicating that the setting has been accepted and stored in the PCM.

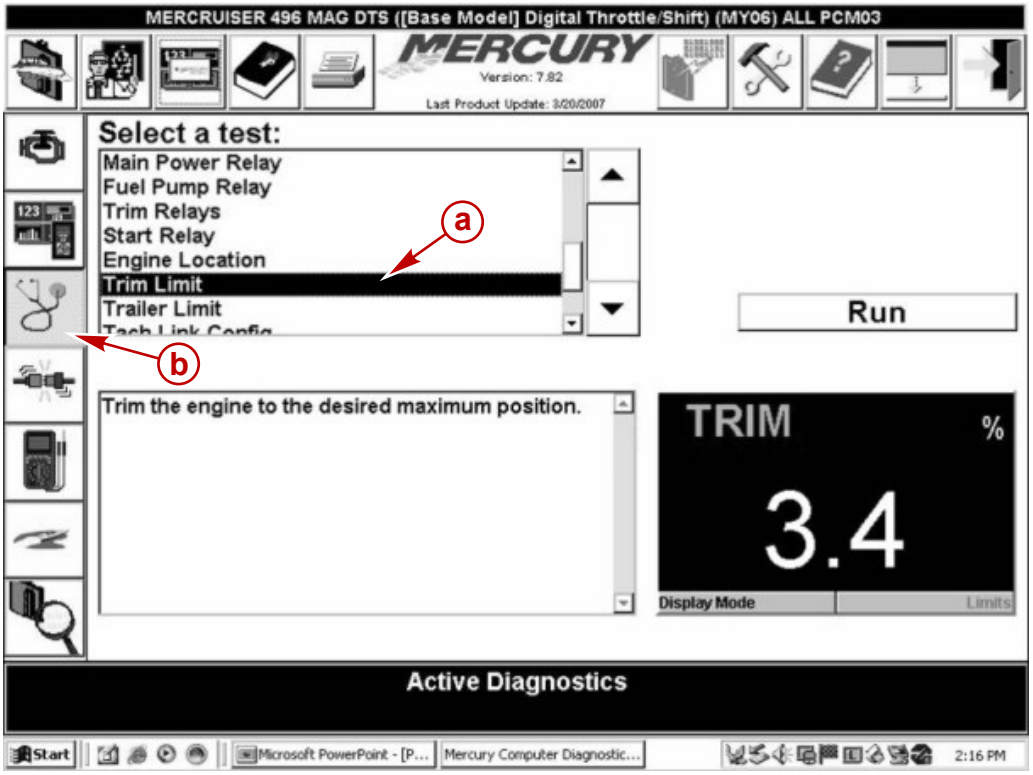
24. The trailer limit is set and trim limit can now be set.



30993

a - Disregard on these models
b - Notice in blue text

25. Click on the Trim Limit test function.

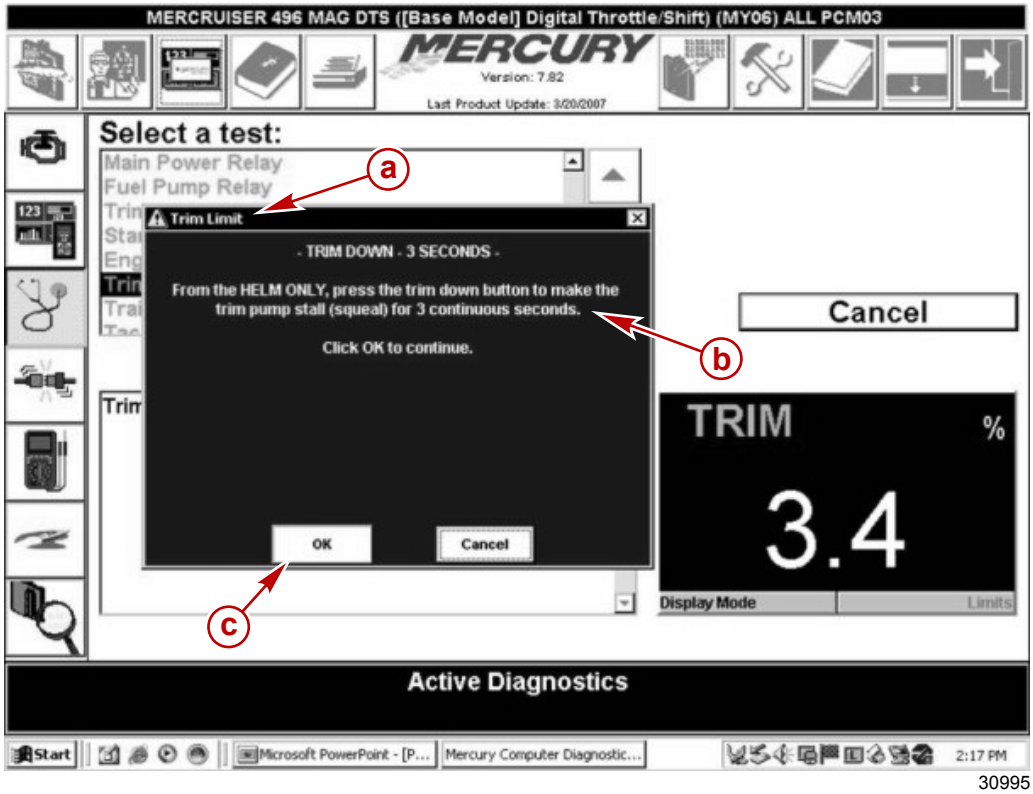


30994

a - Trailer limit function selected
b - Active Diagnostic icon selected

26. A blue dialog box will open with instructions..
27. Working **only from the helm**, press the trim down button until the trim pump stalls (squeals) for 3 continuous seconds.

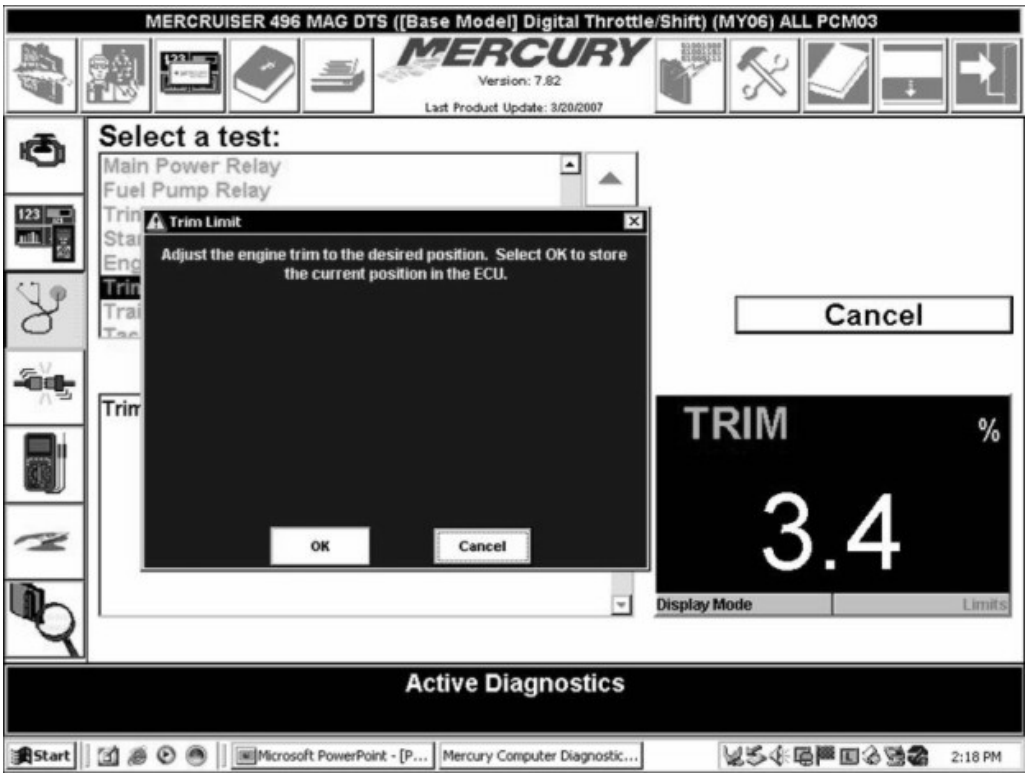
28. Click OK to continue.



30995

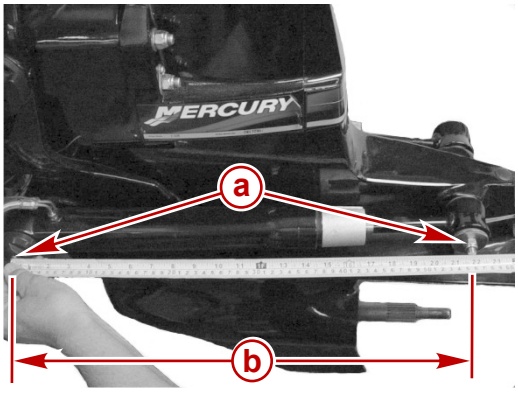
a - Blue dialog box (Trim Limit)
b - Instructions
c - OK button

29. Push the trim button to trim the drive out. The desired position, or distance between anchor pin centers, is 55.24 cm (21-¾ in.).



30996

CDS screen on trim limit dialog box



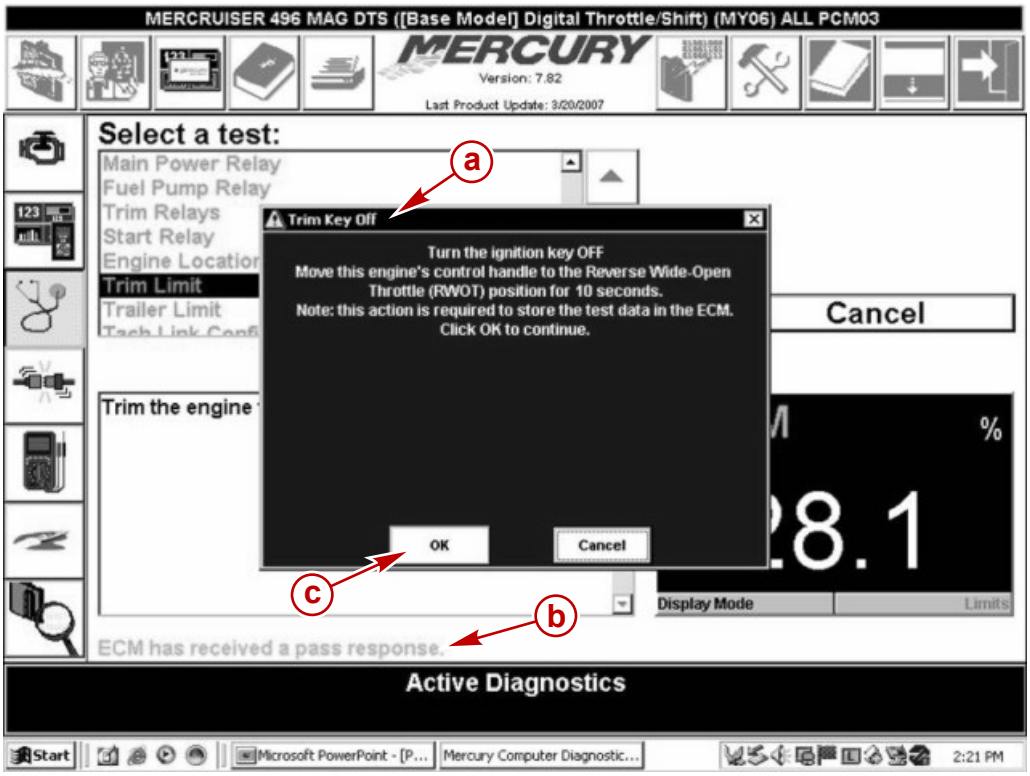
30997

Desired trimmed up position

a - Anchor pin
b - Measurement

30. After the measurement is confirmed, click OK to proceed.
31. Once you click the OK button in the blue dialog box, another blue dialog box will appear giving new instructions.
32. Turn the ignition key off.
33. Move the ERC levers to the reverse WOT position for 10 seconds. This step is required to store the data in the PCM.

34. After the notice with red text appears near the bottom of the CDS screen stating that the response was received, click the OK button.

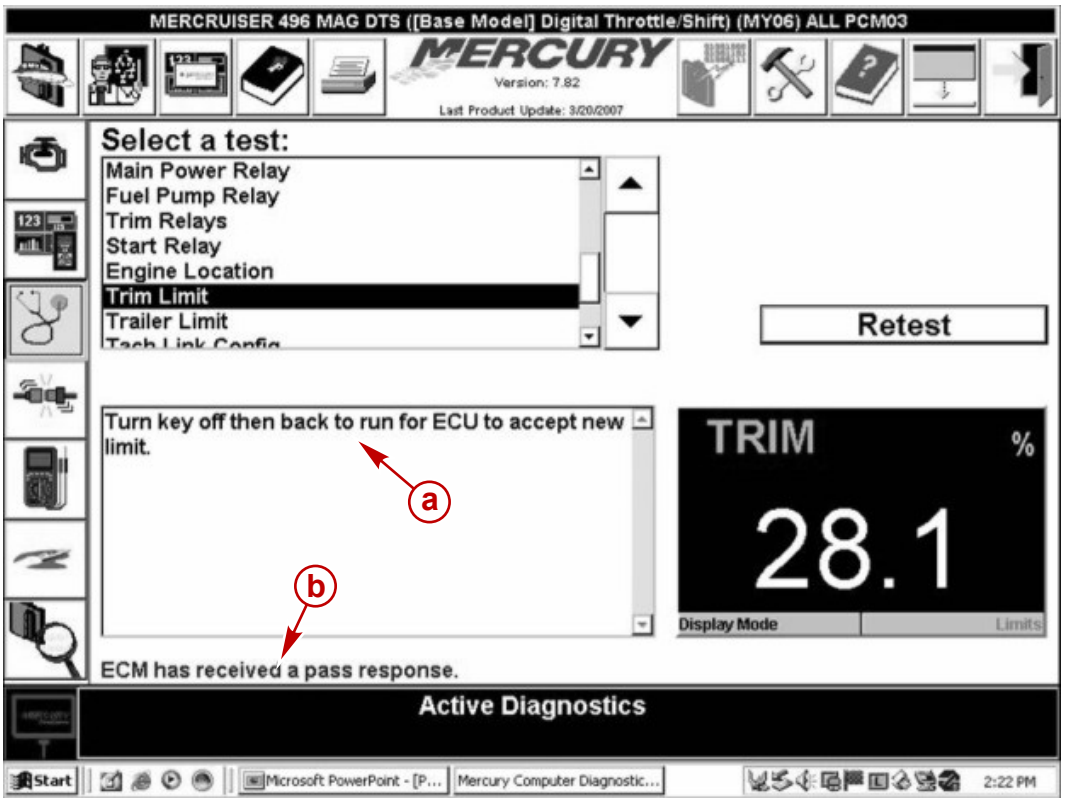


30998

a - Blue dialog box
b - Notice in red text
c - OK button

NOTE: *On MY 2006 and above DTS models, disregard the dialog box instructions to turn the key off and then back to run. Those instructions apply to earlier DTS models. Turn the key switch on or off only as instructed in these steps.*

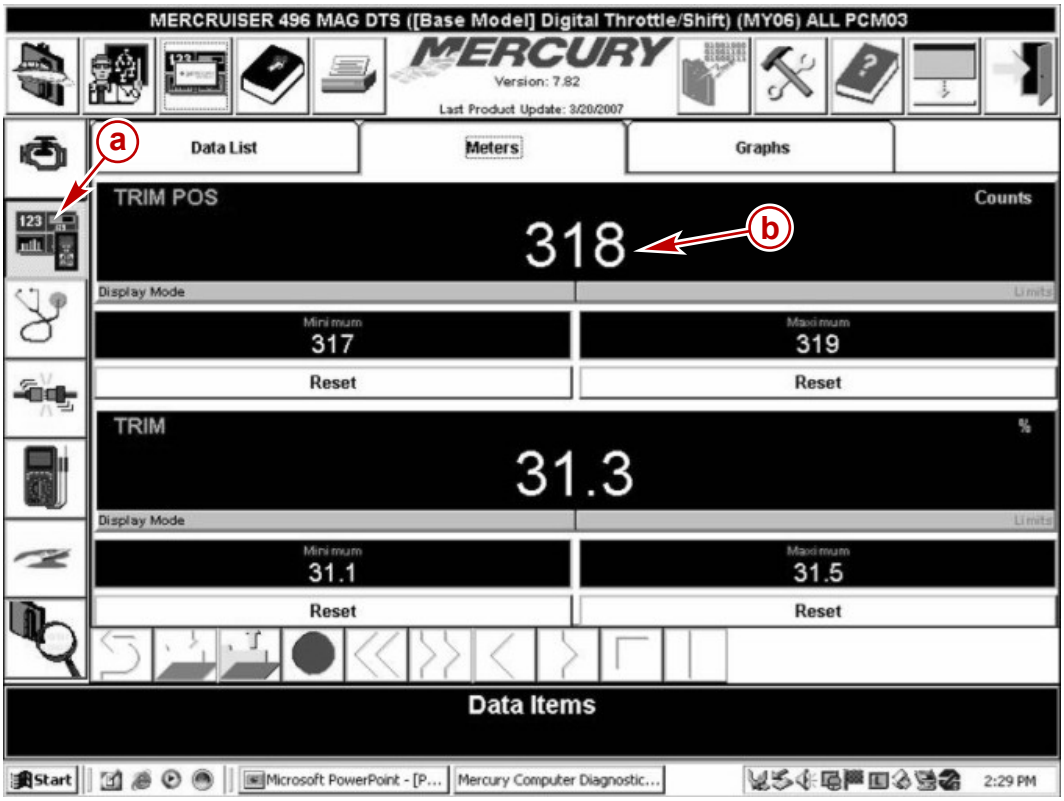
35. The change in the notice from red text to blue text indicates that the setting has been stored in the PCM. The trim limit set up is complete.



30999

a - Disregard on these models
b - Notice in blue text

IMPORTANT: If the PCM fails a test on Trim Limit, go to the Data Items list and look at trim position counts on the meters screen. From the initial starting point on setting Trailer Limit the Bravo One and Two were at 137 counts and the Bravo Three was at 143 counts. You can only "trim" an addition 180 counts to that starting point of 137 or 143. The count below is 318 which is 175 counts added to the starting point of 143. This is within the specified 55.24 cm (21-¾ in.) measurement on trim limit. Any thing outside 180 counts is beyond the specified measurement.



31000

Example of trim position count on CDS screen

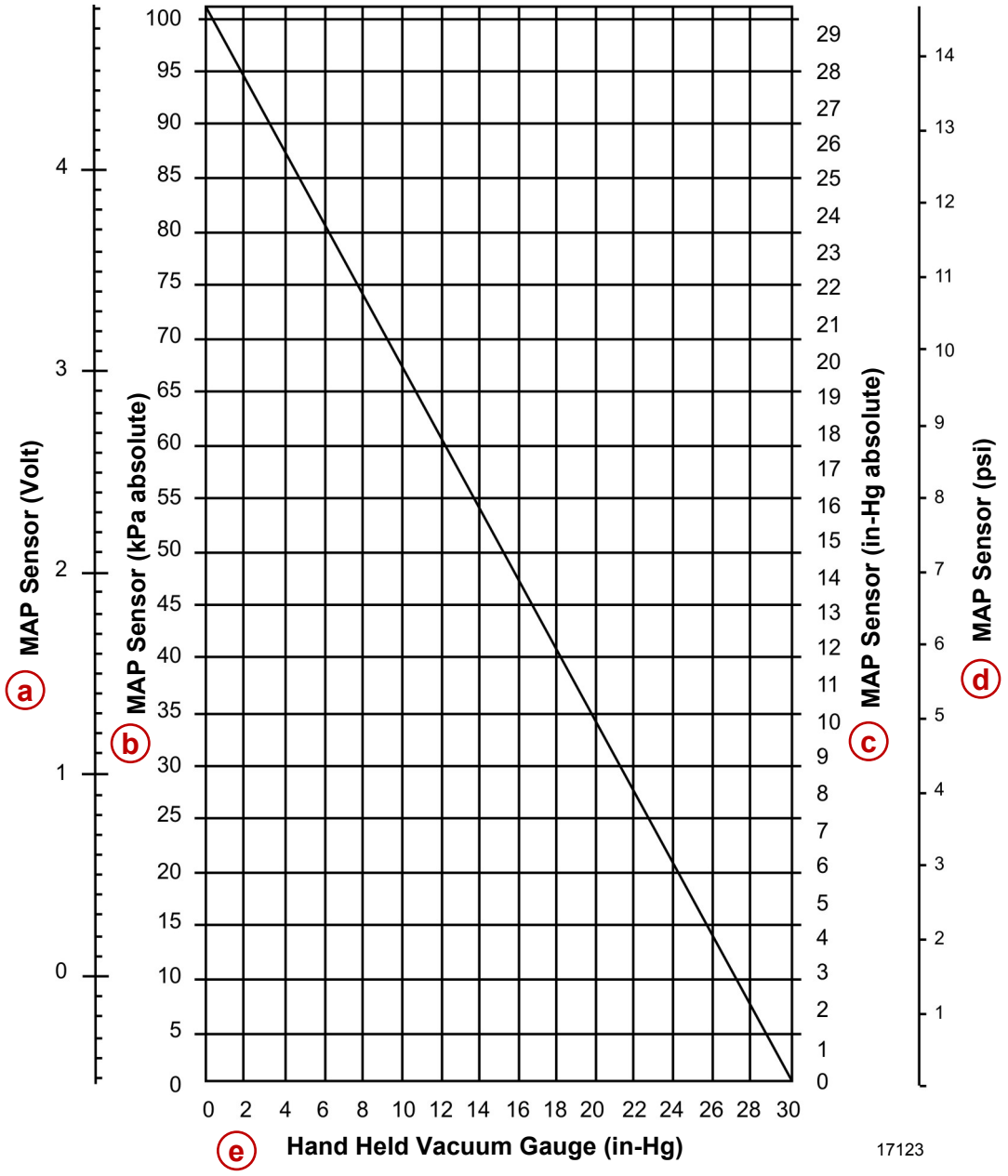
a - Data Items icon selected **b -** Trim position counts

General Reference Charts

Manifold Vacuum and Pressure

Manifold Vacuum	Absolute Pressure		Manifold Vacuum	Absolute Pressure	
psi	psi	kPa	psi	psi	kPa
0	14.7	101.3	7 1/4	7.45	51.4
1/4	14.45	99.6	7 1/2	7.2	49.6
1/2	14.2	97.9	7 3/4	6.95	47.9
3/4	13.95	96.2	8	6.7	46.2
1	13.7	94.4	8 1/4	6.45	44.5
1 1/4	13.45	92.7	8 1/2	6.2	42.7
1 1/2	13.2	91.0	8 3/4	5.95	41.0
1 3/4	12.95	89.3	9	5.7	39.3
2	12.7	87.5	9 1/4	5.45	37.6
2 1/4	12.45	85.8	9 1/2	5.2	35.8
2 1/2	12.2	84.1	9 3/4	4.95	34.1
2 3/4	11.95	82.4	10	4.7	32.4
3	11.7	80.6	10 1/4	4.45	30.7
3 1/4	11.45	78.9	10 1/2	4.2	29.0
3 1/2	11.2	77.2	10 3/4	3.95	27.2
3 3/4	10.95	75.5	11	3.7	25.5
4	10.7	73.8	11 1/4	3.45	23.8
4 1/4	10.45	72.0	11 1/2	3.2	22.1
4 1/2	10.2	70.3	11 3/4	2.95	20.3
4 3/4	9.95	68.6	12	2.7	18.6
5	9.7	66.9	12 1/4	2.45	16.9
5 1/4	9.45	65.1	12 1/2	2.2	15.2
5 1/2	9.2	63.4	12 3/4	1.95	13.4
5 3/4	8.95	61.7	13	1.7	11.7
6	8.7	60.0	13 1/4	1.45	10.0
6 1/4	8.45	58.2	13 1/2	1.2	8.3
6 1/2	8.2	56.5	13 3/4	0.95	6.5
6 3/4	7.95	54.8	14	0.7	4.8
7	7.7	53.1	14 1/4	0.45	3.1
			14 1/2	0.2	1.4

Vacuum Gauge versus MAP Sensor



This graph is correct at sea level only

a - MAP Sensor (Volt)
b - MAP Sensor (kPa absolute)
c - Hand-Held Vacuum Gauge (in.Hg)
d - MAP Sensor (in.Hg absolute)
e - MAP Sensor (psi)

Centigrade to Fahrenheit Conversion

Centigrade	Fahrenheit	Centigrade	Fahrenheit
-55	-67	85	185
-50	-58	90	194
-45	-49	95	203
-40	-40	100	212
-35	-31	105	221
-30	-22	110	230
-25	-13	115	239
-20	-4	120	248
-15	5	125	257
-10	14	130	266
-5	23	135	275
0	32	140	284
5	41	145	293
10	50	150	302
15	59	155	311
20	68	160	320
25	77	165	329
30	86	170	338
35	95	175	347
40	104	180	356
45	113	185	365
50	122	190	374
55	131	195	383
60	140	200	392
65	149	205	401
70	158	210	410
75	167	215	419
80	176	220	428

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Troubleshooting

Section 2A - Troubleshooting

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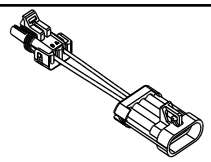
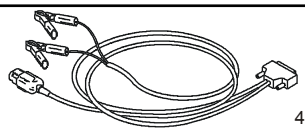
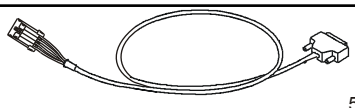
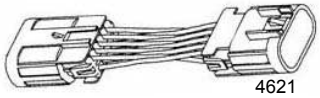
Special Tools

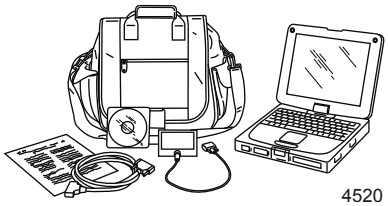
2-Pin to 4-Pin Harness Adapter	84-822560A12
 4679	Adapts the 2-pin Digital Diagnostic Terminal harness to the 4-pin connector on the engine. Use this adapter harness with an 84-822560A05 for MerCruiser product.

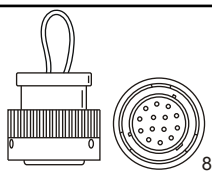
Adapter Harness	84-822560A5
 4009	Data link harness between engine and Computer Diagnostic System (CDS) or Digital Diagnostic Terminal (DDT) on engines with a 2 pin diagnostic connection. Use this adapter harness with an 84-822560A12 for MerCruiser product.

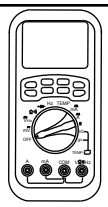
Adapter Harness	84-822560A13
 5826	Data link harness between engine and Computer Diagnostic System (CDS).

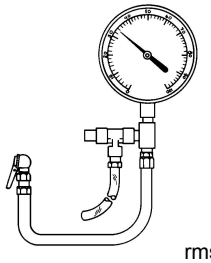
Male to Male 10-Pin Adapter	84-892452A01
 4621	Allows connection between CAN 1 communications cable and Computer Diagnostic System in applications where a junction box is not used.

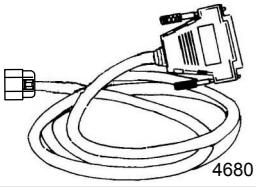
Digital Pressure Meter	91-892651A01
5786	Connects to the fuel system/manifold and can be used in conjunction with Computer Diagnostic System (CDS).

Computer Diagnostic System (CDS)	Order through SPX
 4520	Monitors all electrical systems for proper function, diagnostics, and calibration purposes. For additional information, pricing, or to order the Computer Diagnostic System contact: SPX Corporation 28635 Mound Rd. Warren, MI 48092 or call: USA - 1-800-345-2233 Canada - 800-345-2233 Europe - 49 6182 959 149 Australia - (03) 9544-6222

12 Volt Connector Tool, PCM/ECM Wake-up	91-889675A01
 8036	Connects to data harness allowing operation of the DTS system with the Digital Diagnostic Terminal or CDS.

DMT 2004 Digital Multimeter	91-892647A01
 4516	Measures RPM on spark ignition (SI) engines, ohms, amperes, AC and DC voltages; records maximums and minimums simultaneously, and accurately reads in high RFI environments.

Fuel Pressure Gauge Kit	91-881833A03
 rms32	Tests the fuel pump pressure; can be used to relieve fuel pressure.

CAN 1 Diagnostic Cable	84-892663
 4680	Connects into a junction box or male to male adapter cable for Command Module configuration. Not for use with DDT.

Breakout Box	SPX P/N MM-46225
5974	Connects to the Propulsion Control Module (PCM) to test engine circuits and components without probing wires. May be used with Computer Diagnostic System (CDS).

Terminal Test Probe Kit	SPX P/N MM-46523
7915	Test probes adapt test meter leads to harness connections without damaging harness terminals. May be used with Computer Diagnostic System (CDS).

Troubleshooting Without a Diagnostic Tool

Troubleshooting without a diagnostic tool is limited to checking resistance on the sensors. Typical failures usually do not involve the ECM or PCM. Loose connections or mechanical wear are likely at fault.

- Verify that the engine is in good mechanical condition.
- Verify that the PCM grounds and sensor connections are clean, tight, and in their proper locations.
- Check vacuum hoses for splits, kinks, and improper connections. Check thoroughly for any type of leak or restriction.

- Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
- Check ignition wires for cracking, hardness, and improper routing.
- Inspect wiring for improper connections, pinches, and cuts.
- Check for moisture in primary or secondary ignition circuit connections.
- Check for salt corrosion on electrical connections and exposed throttle body linkages.
- Check fuel pump terminals and fuel pump pressure.
- Verify that the throttle cable is adjusted properly for the TPS at 0%.

Troubleshooting with a Diagnostic Tool—CDS

The Mercury MerCruiser CDS tool has been developed specifically to help technicians diagnose and repair Mercury MerCruiser engines.

This diagnostic tool enables the technician to monitor sensors and ECM/PCM data values and also retrieve stored fault information. The data that can be monitored in real time includes:

Engine RPM	Fuel level
Battery voltage	Manifold air pressure
Available power	Trim
Lake and sea temperature	Idle air control (IAC) pwm percent
Barometric pressure	Oil pressure
Engine coolant temperature	Seawater pump pressure
Throttle position sensor voltage and percent	Manifold air temperature
Pitot	

The diagnostic tool also has the capability of performing several diagnostic tests such as cylinder misfire, injector, IAC, fuel pump relay, and main power relay output or load tests.

Refer to the appropriate reference manual for complete diagnostic tool instructions.

2-Pin to 4-Pin Harness Adapter	84-822560A12
Adapter Harness	84-822560A5
Adapter Harness	84-822560A13
Male to Male 10-Pin Adapter	84-892452A01
Digital Pressure Meter	91-892651A01

Troubleshooting with the CDS Tool

DTS System Troubleshooting

NOTE: *The SmartCraft power harness (supplied with the engine) provides 12 volt power to the helm, and requires connection to the starting battery located at the stern. If the starting battery is located at the helm, the helm DTS power harness may have been installed and the original power harness disconnected from the engine. The helm DTS power harness connects to battery power at the junction box. Before starting the troubleshooting procedures using the 12 volt connector tool, reconnect the original SmartCraft power harness (84-888416A1) to the engine and battery supply.*

The following procedures are used to troubleshoot a DTS system. They are used to determine if system problems are related to engine components or helm components (electronic remote controls, harnesses, DTS command modules, etc.). Ensure the engine battery cables and DTS power harness are connected prior to troubleshooting the DTS system.

The CDS tool must be connected to the engine to troubleshoot PCM faults, and to the helm to troubleshoot command module faults. The CDS can only see engine faults when connected to the engine, and helm faults when connected to the helm. However, a failure at the helm may be the result of a fault at the helm or at the engine. Refer to the ECM/PCM fault lists, the **DTS Command Module Faults**, or the **SmartCraft Systems Terminology** for complete listings of fault codes.

CDS Connection to the Engine

Computer Diagnostic System (CDS)	Order through SPX

1. Connect the 4-pin adapter harness between the engine and the CDS SmartComms box.

Adapter Harness	84-822560A13

2. Disconnect the data cable from the engine.
3. Connect the original power harness if required.
4. Plug the 12-volt connector tool into the data cable connection on the engine. When the connector is first plugged in, the electric fuel pump will operate for two or three seconds on most models.

12 Volt Connector Tool, PCM/ECM Wake-up	91-889675A01

NOTE: *The connector has a jumper wire that connects the 12v (red/purple) battery supply wire to the purple wire in the data cable connector on the engine. This will power up the engine PCM and engine systems, and allow the DTS system to be operated using the CDS.*

5. Connect the SmartComms box to the CDS tool.

CDS Power Up

1. Ensure the ignition key switch is in the "RUN" position.

NOTE: *If a red Mercury SmartComms icon is flashing in the lower left corner of the screen, the CDS software cannot communicate with the SmartComm interface box. If a yellow Mercury SmartComms icon is flashing in the lower left corner of the screen, the SmartComms interface box is detected, but the CDS software cannot communicate with the PCM. Check the connections, ensure the ignition key is turned on, and verify that the correct engine has been selected (identified in the title bar at the top of the screen).*

2. Click on the Engine Select button to enter engine information. Choose the make, model, and serial number range.
3. Enter an engine serial number. When a valid engine serial number is entered, the OK button will appear.
4. Click the OK button to accept the engine information.

Testing DTS Engine Components

1. Ensure the ignition key switch is in the "RUN" position, and that the CDS tool is communicating with the PCM.

NOTE: *If the red Mercury SmartComm icon is flashing, the system cannot establish a connection with the SmartComm interface box. If the yellow Mercury SmartComm icon is flashing, the SmartComm interface box is detected, but communication with the PCM cannot be established. Check the connections, and ensure the ignition key is turned on.*

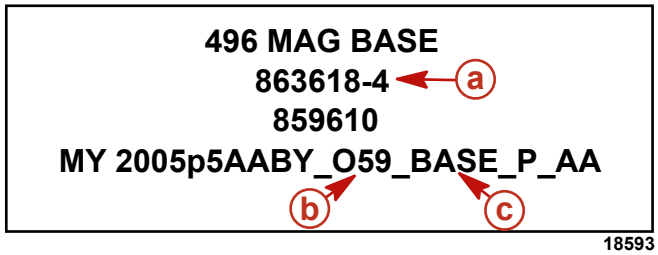
2. Click on the Toolbox button. The faults screen will appear showing the current active faults.
3. Click on the Active Diagnostics button. A list will appear showing the tests available for various engine components. When a test is highlighted, the instructions for that test will appear in the lower window. Follow the instructions to complete the test. Some of the available tests for DTS components are:
   - Electric shift
   - Electric throttle (engine running)
   - Electric throttle (engine not running)
   - Trim relay
   - Start relay
   - Engine location
   - Trim limit
   - Trailer limit
   - Delta trim
   - AutoSync
4. A status bar indicating test progress will appear in the lower left portion of the screen. When the test is completed, a pass or fail notice will appear.

Troubleshooting Worksheet for PCM

PCM Calibration Label

A PCM can be readily identified by the three wire harness connectors (A,B, and C).

The PCM calibration label includes the information necessary to determine the calibration that an engine is equipped with from the factory. The top line is the engine model designation. Use Bravo PCMs only on Bravo models and Inboard PCMs only on inboard models. The second line specifies the simple calibration number and version. In this case it is calibration 863618, version 4. The bottom line lists the model year of the PCM, in this case 2005, followed by detailed identification numbers of the exact calibration. Ensure that you have this information before calling Customer Service.



Typical ECM Calibration Label

a - Calibration Part Number
b - Software Version Identification
c - Base or High Output (HO) engine Designation

Data Collection

The following charts can be filled out to help troubleshoot problems with the engine. With this information the Mercury MerCruiser Customer Service personnel will be better able to identify the potential problem.

PCM 555/ECM 555 Scan Tool Worksheet

Dealer #			Seawater Temperature		
Engine S/N			Ambient Air Temperature		
Engine Type			Engine Run Time		
ECM/PCM Part #			Altitude		
Exhaust			Propeller Pitch		
Drive Type And Ratio			Propeller Type	Stainless Steel	Aluminum
Idle / Closed Throttle / Neutral					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kPa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kPa	psi	OIL (pressure)	kPa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kPa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kPa	psi
SPARK ANG BTDC					
Write Notes Here					

Idle / Closed Throttle / In Gear					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kPa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kPa	psi	OIL (pressure)	kPa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kPa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kPa	psi
SPARK ANG BTDC					
Write					
Notes					
Here					

In Gear 2000 rpm					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kPa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kPa	psi	OIL (pressure)	kPa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kPa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kPa	psi
SPARK ANG BTDC					
Write					
Notes					
Here					

In Gear 3000 rpm					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kPa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kPa	psi	OIL (pressure)	kPa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kPa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kPa	psi
SPARK ANG BTDC					
Write					
Notes					
Here					

WOT / In Gear / Trim					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kPa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kPa	psi	OIL (pressure)	kPa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kPa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kPa	psi
SPARK ANG BTDC					
Write					
Notes					
Here					

PCM 555/ECM 555 CDS Worksheet

The CDS creates an electronic file that can be downloaded to a customer service representitive if additional help is needed in determining the cause of a problem. A typical printout contains the following types of data:

Mercury Marine Computer Diagnostic System		
Vehicle:	MERCRUISER 496 MAG DTS ([Base Model] Digital Throttle/Shift) 0M672221 AND UP PCM03	
Serial Number: 0M999999		
XYZ MARINE 123		
SILVER LAKE ROAD		
ANYTOWN		
WI		
Phone:	555-555-1212	
Fax:		
Data List		
Friday, October 22, 2006	11:31 AM	
Description	**Value**	**Units**
Engine Speed	0	RPM
Battery	12.14	Volts
Power 1	4.99	Volts
Power 2	4.99	Volts
Manifold Pressure	29.21.	In. Hg
Block / Sea Pump Pressure	0.00	kPa
Baro Pressure	29.22	In. Hg
TPS 1	0.830	Volts
TPS 2	0.864	Volts
Throttle Position	8.75	%
Spark Advance	6	BTDC
Available Power	6	%
Guardian due to:	None	
Demand	0.00	%
Load	48	%
Knock 1	0.000	kHz
Knock 2	0.000	kHz
Actual Gear Position	Fwd	
Engine Coolant Temperature	77	F
Starboard EMCT	70	F
Port EMCT	72	F
Manifold Air Temp	79	F
Total FPC	2.09	oz
Oil Pressure	3.9	kPa
Lake / Sea Temperature	73	F
Paddle Wheel	0	Hz
Pitot	25	Counts
Fuel Level	1022	Counts
Trim Position	0.0	%

Preliminary Checks

Several of the diagnostic procedures call for the completion of a Visual / Physical Checklist. The importance of this step cannot be stressed strongly enough. It can lead to correcting a problem without further checks and can save valuable time. This check is outlined below:

Visual / Physical Checklist

Step	Action	Yes	No
1.	Is the battery fully charged?	Go to Step 2.	Replace battery. Restart checklist.
2.	Are the battery cable connections clean and tight?	Go to Step 3.	Clean or tighten battery cable connections. Go to Step 3.
3.	Are the external engine grounds tight and clean?	Go to Step 4.	Clean or tighten engine grounds. Go to Step 4.
4.	Check fuel line and fuel line connections for leaks, corrosion and blockage. Was a problem found?	Repair problem. Go to Step 5.	Go to Step 5.
5.	Check the 4 fuses located next to the ECM on the engine. Are the fuses good?	Go to Step 6.	Replace fuse. Go to Step 6.
6.	Check the 50-amp circuit breaker located on the engine to ensure that the circuit is closed. Was the circuit breaker tripped?	Reset the circuit breaker. Go to Step 7.	Go to Step 7.
7.	Is the lanyard stop switch in the wrong position?	Toggle switch. Go to Step 8.	Go to Step 8.
8.	Are you using the correct version of scan tool software for the engine in question?	Go to OBD System Chart.	Obtain appropriate version of software. Go to OBD System Chart.

On-Board Diagnostic (OBD) System Chart

Step	Action	Yes	No
1	Was the Visual / Physical Checklist completed?	Go to Step 2.	Go to Visual / Physical Checklist.
2	Connect scan tool to the engine. Ignition ON. Is the scan tool communicating with the ECM?	Go to Step 10.	Go to Step 3
3	Ignition ON. Check for battery voltage (B+) at Pin 5 of the 10-pin connector or Pin 3 of the 14-pin connector coming from the helm. Ignition OFF. With the ignition ON, was B+ present?	Go to Step 4.	Locate and repair problem from the keyswitch to the engine 10-pin connector. Re-test system.
4	Ignition ON. Check for B+ at PCM Connector A-1. Ignition OFF. With the ignition ON, was B+ present?	Go to Step 6.	Go to Step 5
5	Check for continuity between Pin 5 of the 10-pin Connector of the engine harness and ECM Connector B-18. Was continuity present?	Go to Step 6.	Locate and repair the open in the harness. Re-test system.
6	Ignition ON. Check for B+ at Diagnostic connector Pin D. Ignition OFF. With the ignition ON, was B+ present?	Go to Step 7.	Repair or replace harness. Re-test system.
7	Check continuity of the ground wire, Diagnostic connector Pin A and Pin 1 of the 10-pin or Pin C of the 14-pin Connector . Was continuity present?	Go to Step 8.	Locate and repair the open in the harness. Re-test system.
8	Check continuity between Diagnostic connector Pin B and ECM connector A-12. Was continuity present?	Go to Step 9.	Locate and repair the open in the harness. Re-test system.
9	Check continuity between Diagnostic connector Pin C and ECM connector A-5. Was continuity present?	Replace ECM.	Locate and repair the open in the harness. Re-test system.
10	Using the scan tool, check for faults stored in the ECM. Were any faults present?	Inspect. and repair fault. Re-test system.	Go to appropriate symptom chart.

Symptom Charts

The following symptom charts provide the mechanic a quick method of finding the possible cause of a problem.

DMT 2004 Digital Multimeter	91-892647A01

Chart A-1 Engine Cranks Over but Will Not Start

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Go to the OBD Chart.
3.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 4.	Go to Chart A-2.
4.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Turn ignition to "ON." Fuel pump will operate for 3–5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	Go to step 5.	Go to Chart A-3.
5.	Complete a compression test on the engine. See compression test procedures. **Was a problem found?**	Locate and repair. Retest system.	Go to the OBD Chart.

Chart A-2 Main Power Relay Test

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Go to the OBD Chart.
3.	Turn ignition to "ON." Listen for the Main Power Relay (MPR). Turn ignition to "OFF." **With initial ignition ON, did the Main Power Relay turn on (should hear a click)?**	Go to Chart A-5.	Go to step 4.
4.	Remove the MPR. Turn ignition to "ON." Using the DMT connected to ground, check for B+ MPR harness connector terminal 30 and 86. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 5.	Locate and repair the open or short in the harness. Retest system.
5.	Check for continuity between the MPR harness connector terminal 85 and the ECM harness connector A-22. **Was continuity present?**	Install a known good MPR onto the engine. Retest system.	Locate and repair the open or short in the harness. Retest system.

Chart A-3 Fuel System Electrical Test

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Turn ignition to "ON." Listen for the fuel pump to operate. Turn ignition to "ON." **Did the fuel pump operate for 3–5 seconds?**	Go to Chart A-4.	Go to step 4.
4.	Turn ignition to "ON." Using the DMT connected to ground, check for B+ at the fuel pump harness connector A. Turn ignition to "ON." **With the ignition ON, was B+ present?**	Install a known good fuel pump. Retest system.	Go to step 5.
5.	Remove fuel pump relay (FPR). Turn ignition to "ON." Using the DMT connected to ground, check for B+ at FPR harness connector terminal 30. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 6.	Locate and repair the open or short in the harness. Retest system.
6.	Check for continuity between FPR harness connector terminal 86 and ECM harness connector A-19. **Was continuity present?**	Install a known good FPR. Retest system.	Locate and repair the open or short in the harness. Retest system.

Chart A-4 Fuel System Diagnosis

Before starting fuel system diagnosis, verify that fuel is in the tank.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Turn ignition to "ON." Fuel pump will operate for 3–5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	Go to step 4.	Go to step 6.
4.	Attempt to start the engine and idle at normal operating temperatures. **Did the engine start?**	Go to step 5.	Go to step 7.
5.	With the engine idling, connect an external vacuum source to the fuel pressure regulator and apply 34 kPa (10 in.)Hg of vacuum. **Did fuel pressure decrease by approximately 34.5 kPa (5 PSI)?**	Problem is intermittent or the fuel supply to the engine is low or restricted.	Replace faulty fuel pressure regulator. Retest system.
6.	**Was fuel pressure present?**	Go to step 7.	Go to Chart A-3.
7.	**Does the system establish fuel pressure and then quickly decrease to 0 kPa (0 PSI)?**	Go to step 8.	Retest system
8.	Turn ignition to "OFF." Block fuel pressure line between the fuel pump and the fuel rail. Turn ignition to "ON." **Does fuel pressure remain steady?**	Locate and repair leaking fuel injectors or fuel line connections.	Go to step 9.
9.	Turn ignition to "OFF." Block fuel return line using the fuel shut off valve tool. Turn ignition to "ON." **Does fuel pressure remain steady?**	Replace faulty fuel pressure regulator. Retest system.	Install a known good fuel pump. Retest system.

Chart A-5 Ignition System Test

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Install an analog tachometer to the auxiliary tachometer lead located near the PCM. Try to start the engine. Turn ignition to "OFF." **Was there any tachometer signal on the analog tachometer while cranking the engine?**	Go to step 4.	Confirm tachlink configured correctly. Engine mechanical problem, go to appropriate Mercury MerCruiser service manual.
4.	Check spark plug wires for open circuits, cracks in the insulation or improper seating of the terminals at the spark plugs, distributor cap, and coil tower. **Was a problem found?**	Locate and repair or replace. Retest system.	Go to step 5.
5.	Check for adequate spark at all of the spark plugs.**Was adequate spark present?**	Go to step 6.	Go to step 7.
6.	Check spark plugs for damage and wear. **Was a problem found?**	Replace with a new spark plug gapped correctly.	Go to step 12.
7.	Turn ignition to "ON." Using the DMT, check for B+ at the coil connector A on 5.0L. 5.7L, and 6.2L, or on connector H on the 8.1L/496 cid. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 8.	Locate and repair the open in the harness. Retest system.
8.	Check for continuity between the coil harness connectors B and C, and the coil driver harness connector D on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 9.	Locate and repair the open in the harness. Retest system.
9.	Turn ignition to "ON." Using DMT, check for B+ at coil driver harness connector A on 5.0L. 5.7L, and 6.2L engines. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 10.	Locate and repair the open in the harness. Retest system.

Step	Action	Yes	No
10.	Check continuity between the coil driver harness connector C and the engine ground on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 11.	Locate and repair the open in the harness. Retest system.
11.	Check continuity between the coil driver harness connector B and the ECM connector B-23 on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Replace the coil and coil driver. Retest system.	Locate and repair the open in the harness. Retest system.
12.	Disconnect the harness from the Crankshaft position sensor (CPS). Turn ignition to "ON." Using a DMT connected to ground, check for 5-volt power at harness connector A. Turn ignition to "OFF." **With the ignition ON, was 5-volt power present?**	Go to step 13.	Locate and repair the open in the harness. Retest system.
13.	Check continuity between CPS harness connector B and engine ground. **Was continuity present?**	Go to step 14.	Locate and repair the open in the harness. Retest system.
14.	Check continuity between CPS harness connector C and ECM harness connector B-10 on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 15.	Locate and repair the open in the harness. Retest system.

Chart A-6 Hard Start Symptom

Definition: Engine cranks, but takes a long time to start.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 4
4.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 5.	Go to Chart A-2.

Step	Action	Yes	No
5.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Turn ignition to "ON." Fuel pump will operate for 3–5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	Go to step 6.	Go to Chart A-3.
6.	**Is a scan tool being used?**	Go to step 8.	Go to step 7.
7.	Check for an ECT sensor shifted in value. With the engine completely cool, measure the resistance of the ECT sensor. See to the ECT single circuit diagram in section 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Are the readings similar?**	Go to step 10.	Replace the ECT sensor. Retest system.
8.	Check for an ECT sensor shifted in value. Using the scan tool with the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature. **Are the temperatures within 5.5° C (10° F) of each other?**	Go to step 9.	Replace the ECT sensor. Retest system.
9.	Using the scan tool, display ECT sensor temperature and record value. Check the resistance of the ECT sensor. See the ECT single circuit diagram in section 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Is the ECT sensor temperature near the resistance temperature?**	Go to step 10. Retest the system.	Locate and repair high-resistance or poor connection in the ECT signal circuit or the ECT sensor ground.
10.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness.	Go to step 11
11.	Using the scan tool, check for proper operation of the TP sensor. Check throttle linkage for sticking, binding, or wear. **Was a problem found?**	Locate and repair the problem with the TP sensor or the throttle linkage. Retest system.	Go to step 12.

Step	Action	Yes	No
12.	Check for the following: ☐ Low compression ☐ Leaking cylinder head gaskets ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐ Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to appropriate Mercury MerCruiser Service Manual.	Go to step 13.
13.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-7 Engine Surges Symptom

Definition: Engine power variation under steady throttle. Feels like the engine speeds up or slows down with no change in the throttle lever position.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 4.
4.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 5.
5.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, the cause of the fouling must be determined before replacing the spark plugs. **Were the spark plugs damaged?**	Replace the spark plugs.	Go to step 6.
6.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Retest system	Go to step 7.

Step	Action	Yes	No
7.	Check the integrity of the primary and secondary wiring. Check wire routing. Check the condition of the distributor, distributor cap, and spark plug wires. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace bad distributor or spark plug wires. Retest system.	Go to step 8.
8.	Check the vacuum hoses for splits, kinks, and improper connections. **Was a problem found?**	Repair or replace the vacuum hoses.	Go to step 9.
9.	Check the fuel injectors wiring harness for improper connections and intermittent opens or shorts. **Was a problem found?**	Repair or replace the fuel injector harness. Retest system.	Go to step 10.
10.	Inspect ECM harness connections and ground connections for being tight, clean, and connected properly. **Was a problem found?**	Repair. Retest system.	Go to step 11.
11.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 12.	Review charging system. Refer to the appropriate Mercury MerCruiser service manual.
12.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-8 Lack of Power, Sluggish, or Spongy Symptom

Definition: Engine delivers less than expected power. Little or no increase in speed when throttle lever is advanced partially.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	**Is engine in Guardian Strategy?**	Verify engine fault and repair.	Go to step 4.
4.	If possible compare engine performance with a engine of the same model. **Is the engine performance similar?**	No problem found.	Go to step 5.
5.	Check flame arrestor for dirt, damage, or any restriction. **Was a problem found?**	Clean or replace the flame arrestor.	Go to step 6.

Step	Action	Yes	No
6.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 7.
7.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 8.
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, the cause of the fouling must be determined before replacing the spark plugs. **Were the spark plugs damaged?**	Replace the spark plugs.	Go to step 9.
9.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Retest system	Go to step 10.
10.	Check for intermittent open or shorts in the ECT sensor, MAP sensor, TP sensor, and KS sensor. **Was a problem found?**	Locate and repair the open or short in the harness.	Go to step 11.
11.	Inspect ECM harness connections and ground connections for being tight, clean, and connected properly. **Was a problem found?**	Repair. Retest system.	Go to Step 12.
12.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 13.	Review charging system. Refer to the appropriate Mercury MerCruiser service manual.
13.	Check for the following: ☐ Low compression ☐ Leaking cylinder head gaskets ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐ Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to the appropriate Mercury MerCruiser service manual.	Go to step 14.
14.	Check for excessive resistance on the bottom of the boat such as dirt or barnacles. Check for proper propeller size and pitch for the boat application. **Was a problem found?**	Clean the boat bottom. Retest system.	Go to step 15.

Step	Action	Yes	No
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-9 Detonation or Spark Knock Symptom

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	**Is the engine propped to operate in the recommended operating RPM range?**	Go to step 4.	Check propping procedures.
4.	Check for correct spark plug number. Check the spark plugs for the correct gap, heat range, and damage. **Was a problem found?**	Replace with specified spark plugs.	Go to step 5.
5.	Check the spark plug wires for continuity or damage. **Was a problem found?**	Replace the questionable spark plug wire. Retest system.	Go to step 6
6.	Check for cracks, damage, or breaks of the distributor, distributor cap, or rotor. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace. Retest system.	Go to step 7.
7.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 8.
8.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 9.
9.	**Is the engine operating above the normal temperature range?**	Go to step 10.	Go to step 11.
10.	Check for obvious overheating issues: ☐ Loose serpentine belt ☐ Faulty or incorrect seawater pump ☐ Restriction in the cooling system ☐ Faulty or incorrect thermostat **Was a problem found?**	Repair or replace. Retest system.	Go to step 11.
11.	**Is a scan tool being used?**	Go to step 13.	Go to step 12.

Step	Action	Yes	No
12.	Check for an ECT sensor shifted in value. With the engine completely cool, measure the resistance of the ECT sensor. See the ECT single circuit diagram in section 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Are the readings similar?**	Go to step 14.	Replace the ECT sensor. Retest system.
13.	Check for an ECT sensor shifted in value. Using the scan tool with the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature. **Are the temperatures within 5.5° C (10° F) of each other?**	Go to step 14.	Replace the ECT sensor. Retest system.
14.	Check for the following: ☐ Low compression ☐ Leaking cylinder head gaskets ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐ Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to the appropriate Mercury MerCruiser service manual.	Go to step 15.
15.	Check for loose fasteners, sensors, and connections.	Tighten and secure.	Go to step 16
16.	Using an engine cleaner, remove excessive carbon buildup from the combustion chambers. Refer to instructions on the engine cleaner. Retest system. **Is detonation still present?**	Go to step 17.	--
17.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-10 Hesitation, Sag, or Stumble Symptom

Definition: Momentary lack of response as the throttle lever is advanced. Can occur at all engine speeds, but usually more severe when first starting out. May cause engine to stall in severe cases.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD
3.	Inspect flame arrestor for restrictions, dirt, or damage. **Was a problem found?**	Clean or replace flame arrestor. Retest system.	Go to step 4

Step	Action	Yes	No
4.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness. Retest system.	Go to step 5.
5.	Using the scan tool, check for proper operation of the TP sensor. Check throttle linkage for sticking, binding, or wear. **Was a problem found?**	Locate and repair the problem with the TP sensor or the throttle linkage. Retest system.	Go to step 6.
6.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 7.
7.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 8.
8.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 9.
9.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, determine the cause of the fouling before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to step 10.
10.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 11.	Review charging system. Refer to the appropriate Mercury MerCruiser service manual.
11.	Check for obvious overheating issues: ☐ Loose serpentine belt ☐ Faulty or incorrect seawater pump ☐ Restriction in the cooling system ☐ Faulty or incorrect thermostat **Was a problem found? .**	Repair or replace. Retest system.	Go to step 12.
12.	Check for the following: ☐ Low compression ☐ Deposits on the intake valves **Was a problem found?**	Engine mechanical problem, refer to the appropriate Mercury MerCruiser service manual.	Go to step 13.
13.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-11 Engine Misses Symptom

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle, low speed, or on hard acceleration. Fuel starvation can cause engine to miss.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Verify that the high-voltage switch (distributor) is aligned properly. Refer to the appropriate Mercury MerCruiser service manual for instructions. **Was a problem found?**	Align properly. Retest system.	Go to step 4.
4.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 5.
5.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 6.
6.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 7.
7.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 8.	Go to Chart A-2
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to step 9.
9.	Check for the following: ☐ Low compression ☐ Sticking or leaking valves ☐ Bent push rods ☐ Worn rocker arms ☐ Broken valve springs ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to appropriate Mercury MerCruiser service manual.	Go to step 10.

Step	Action	Yes	No
10.	Check intake and exhaust manifolds for casting flash. **Was a problem found?**	Repair or replace. Retest system.	Go to step 11.
11.	Check for electromagnetic interference (EMI). A missing condition can be caused by EMI on the reference circuit. EMI can usually be detected by monitoring engine RPM with a scan tool or tachometer. A sudden increase in RPM with little change in actual engine RPM, indicates EMI is present. **Was a problem found?**	Locate and correct the EMI source. Retest system.	Go to step 12.
12.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-12 Rough, Unstable, or Incorrect Idle and Stalling Symptom

Definition: Engine operates unevenly at idle. If severe, the engine or vessel may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 4.
4.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 5.
5.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 6.
6.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 7.	Go to Chart A-2
7.	Check for cracks, damage, or breaks of the distributor, distributor cap, or rotor. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace. Retest system.	Go to step 8

Step	Action	Yes	No
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, determine the cause of the fouling before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to step 9.
9.	Check for the following: ☐ Low compression ☐ Vacuum leaks ☐ Sticking or leaking valves ☐ Bent push rods ☐ Worn rocker arms ☐ Broken valve springs ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐ Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to the appropriate Mercury MerCruiser service manual.	Go to step 10.
10.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-13 Poor Fuel Economy Symptom

Definition: Fuel economy is noticeably lower than expected. Also, economy is now lower than it was on this engine at one time.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check operators driving habits. Are excessively heavy loads being carried? Is operator accelerating too much, too often? **Was a problem found?**	System normal.	Go to step 4
4.	Check all fuel lines and connections for leaks. **Was a problem found?**	Repair or replace. Retest system	Go to step 5.
5.	Check for excessive resistance on the bottom of the boat such as dirt or barnacles. Check for proper propeller size and pitch for that application. **Was a problem found?**	Clean boat bottom. Repair or replace the propeller.	Go to step 6.
6.	Check flame arrestor for dirt, damage, or any restriction? **Was a problem found?**	Clean or replace the flame arrestor.	Go to step 7.

Step	Action	Yes	No
7.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 8.
8.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 9.
9.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 10.
10.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 11.	Go to Chart A-2.
11.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 12.
12.	Check the vacuum hoses for splits, kinks, and improper connections. **Was a problem found?**	Repair or replace the vacuum hoses.	Go to step 13.
13.	Check engine compression. **Was a problem found?**	Engine mechanical problem, refer to appropriate Mercury MerCruiser service manual.	Go to step 14.
14.	Check exhaust system for possible restriction. Inspect exhaust system for damaged or collapsed pipes. **Was a problem found?**	Repair or replace.	Go to step 15.
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-14 Dieseling or Run-On Symptom

Definition: Engine continues to operate very roughly after the key is moved to the "OFF" position. If engine operates smoothly, check the ignition switch and adjustment.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 4.
4.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 5.
5.	Check for obvious overheating issues: ☐ Loose serpentine belt ☐ Faulty or incorrect seawater pump ☐ Restriction in the cooling system ☐ Faulty or incorrect thermostat **Was a problem found?**	Repair or replace. Retest system.	Go to step 6.
6.	Check the fuel pump relay for proper operation. See Chart A-3. **Was a problem found?**	Repair or replace. Retest system.	Go to step 7.
7.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-15 Backfire Symptom

Definition: Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.
3.	Check flame arrestor for dirt, damage, or any restriction? **Was a problem found?**	Clean or replace the flame arrestor.	Go to step 4.
4.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to step 5.

Step	Action	Yes	No
5.	Check for proper fuel pressure while the condition exists. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 4
6.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 5.
7.	Check spark plug wires for open circuits, cracks in the insulation, or improper seating of the terminals at the spark plugs, distributor cap, and coil tower. **Was a problem found?**	Locate and repair or replace. Retest system	Go to step 8.
8.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Retest system	Go to step 9.
9.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to step 10.	Go to Chart A-2.
10.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to step 11.
11.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness. Retest the system.	Go to step 12.
12.	Check for proper operation of the TP sensor. Check for throttle linkage sticking, binding or wear causing TP sensor voltage to be higher than normal. **Is TP sensor operating improperly or is the voltage higher than normal?**	Locate and repair the problem with the TP sensor or the throttle linkage. Retest system.	Go to step 13.
13.	Check for the following: ☐ Low compression ☐ Sticking or leaking valves ☐ Worn rocker arms ☐ Broken valve springs ☐ Worn camshaft ☐ Improper valve timing or valve train problem ☐ Restricted exhaust system **Was a problem found?**	Engine mechanical problem, refer to the appropriate Mercury MerCruiser service manual.	Go to step 14.

Step	Action	Yes	No
14.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

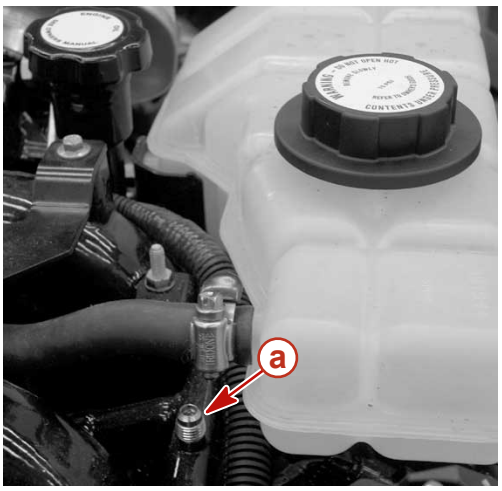
Fuel Pressure Gauge Setup for PCM Engines

⚠ CAUTION

Failure to release pressure from the fuel system will result in fuel spraying out, which can cause a fire or explosion. Allow the engine to cool completely and release all fuel pressure before servicing any part of the fuel system. Always protect eyes and skin from pressurized fuel and vapors.

⚠ WARNING

Fuel is flammable and explosive. Ensure the key switch is off and the lanyard is positioned so that the engine cannot start. Do not smoke or allow sources of spark or open flame in the area while servicing. Keep the work area well ventilated and avoid prolonged exposure to vapors. Always check for leaks before attempting to start the engine and wipe up any spilled fuel immediately.



18594

8.1L/496 cid Engine

a - Schrader Valve Location

Installation

IMPORTANT: Wipe up spilled fuel immediately.

1. Remove Schrader valve cap.
2. Activate the Schrader valve located on the fuel rail to relieve pressure.
3. Using a proper adapter, attach the fuel pressure gauge to the Schrader valve.

Fuel Pressure Gauge Kit	91-881833A03

4. Turn key to the "on" position to purge all of the air from the fuel pressure gauge line.

NOTE: *Turn the key on and off several times to purge the air from the line.*

Test

1. Remove reference line.
2. Turn the key to the "on" position.
3. Observe the reading on the guage. The reading should be within specification.

Fuel Pressure	Reading on Fuel Pressure Guage
With reference line removed	296 kPa +/- 14 kPa (43 psi +/- 2 psi)

4. Corrrect the problem if out of specification.
5. Reattach the reference line.

NOTICE

Failure to provide sufficient cooling water will damage the water pump and cause the engine to overheat. Provide a sufficient supply of water at the water inlets during operation.

6. Provide cooling water to the engine.
7. Turn the engine on.
8. Fuel pressure should be lower than the above specification.
9. Remove the reference line.
10. Observe the reading on the gauge. The fuel pressure should return to full pressure (The same reading as with the engine off.)
11. Reattach the reference line. The pressure should drop back to the initial pressure with the engine running.
12. Turn off the engine.
13. Turn off the cooling water.
14. Correct the problem if out out of specification.

Removal

IMPORTANT: Follow the reccommendations of the fuel pressure gauge manufacturer for the correct procedure for relieving pressure from the system.

1. Relieve the pressure from the fuel system.
2. Remove the fuel pressure gauge from the engine.
3. Install the Schrader valve cap.

Injector Balance Test

Test Procedure

NOTE: *The CDS tool can be used to perform this test. Refer to the CDS tool for additional information on the procedure and any required harness or adapters.*

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop. Injector testers are available from various manufacturers. A pulse width that drops the fuel rail pressure to half the normal operating pressure should be used.

SET-UP

1. Allow the engine to cool for 10 minutes to avoid irregular readings as a result of fuel boiling due to heat soak.

2. Relieve the fuel pressure in the fuel rail.
3. With the ignition off, connect the fuel pressure gauge to the fuel pressure tap.
4. Disconnect the harness connectors at all injectors.
5. Connect the injector tester to one injector.
6. Use the adapter harness furnished with the injector tester to energize the injectors. Follow the instructions provided by the manufacturer for use of the adapter harness.
7. To complete the ECM shutdown cycle, ensure that the ignition remained in the off position for at least 10 seconds.
8. Turn the ignition on and allow the fuel pump to run for about 2 seconds.
9. Insert clear tubing attached to a vent valve into a suitable container and purge air from the gauge and hose to ensure accurate gauge operation.
10. Repeat step 9 until all the air is purged from the gauge.

TESTING

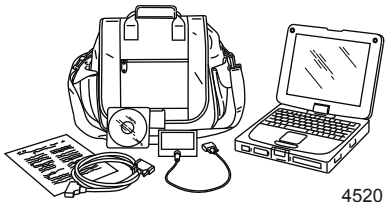
NOTE: *To prevent flooding, do not repeat the entire test more than once without running the engine. This includes any retest on faulty injectors.*

1. Turn the ignition off for 10 seconds and then on and off again several times to get maximum fuel pressure.
2. Record the maximum fuel pressure reading.
3. Energize tester one time and note the pressure drop at its lowest point. Disregard any slight pressure increase after the drop hits its low point.
4. Subtract the second pressure reading from the maximum fuel pressure to get the amount of injector pressure drop.
5. Repeat testing for each injector and compare the amount of drop. Usually, good injectors will have approximately the same amount of fuel pressure drop.

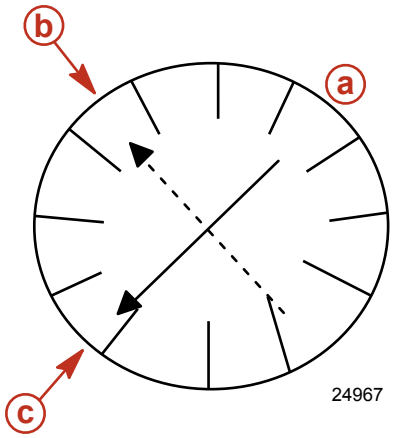
NOTE: *If the pressure drop of all injectors is within 10 kPa (1.5 psi) of the average, the injectors have proper flow.*

6. Retest any injector that has a pressure difference of 10 kPa (1.5 psi) more or less than the average fuel pressure drop of the other injectors on the engine.
7. Replace any injector that retests outside the pressure difference of 10 kPa (1.5 psi) more or less than the average fuel pressure drop of the other injectors on the engine.

TEST EXAMPLE



CDS System



Fuel Pressure Gauge

a - Fuel pressure gauge
b - Second reading of the pressure after drop
c - First reading of initial pressure

Example								
Cylinder	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1st. Reading	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)
2nd Reading	19 psi (131 kPa)	17 psi (117 kPa)	21 psi (145 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)
Amount of Drop	19 psi (131 kPa)	21 psi (145 kPa)	17 psi (117 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)
Status	OK	Rich (Too Much Fuel Drop)	Lean (Too Little Fuel Drop)	OK	OK	OK	OK	OK

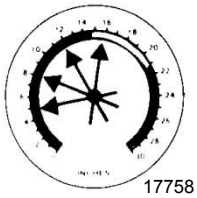
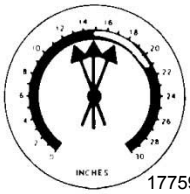
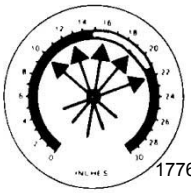
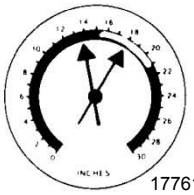
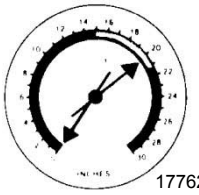
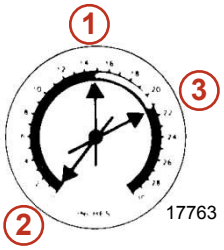
Troubleshooting With a Vacuum Gauge

Most engines have a normal gauge reading of 51–71 kPa (15–21 in. Hg) vacuum. Before using the vacuum gauge the engine must be at normal operating temperature. Use a tachometer to be certain that the engine is running at the specified RPM. The vacuum gauge must be connected to the intake manifold at a manifold vacuum source.

The following table indicates possible malfunctions of various vacuum readings.

Vacuum Gauge Troubleshooting Guide

Gauge Reading	Symptom	Cause	Action
17756	**Steady reading 51-71 kPa (15–21 in. Hg) at idle RPM**	Normal	No action necessary.

Gauge Reading	Symptom	Cause	Action
17757	**Extremely low reading, but indicator steady at idle RPM**	Vacuum leak at intake manifold or carburetor, incorrect timing, or underpowered boat.	Determine the source of the vacuum leak and repair. Replace the propeller. If the problem persists, contact the manufacturer about the correct power package.
 17758	**Indicator fluctuates between high and low at idle RPM**	Blown cylinder head gasket between two adjacent cylinders. (Check with compression test.)	Determine the cause and replace the cylinder head gasket.
 17759	**Indicator fluctuates 13.5–17 kPa (4–5 in. Hg) very slowly at idle RPM**	Valves are sticking or spark plug gap is too narrow.	Adjust carburetor. Inspect the spark plugs and service or replace if necessary. Correct sticking valve.
 17760	**Indicator fluctuates rapidly at idle, steadies as RPM is increased**	Valve guides may be worn.	Ream the valve guides and install a valve with an oversized stem or replace the cylinder head.
 17761	**Continuously fluctuates between low and normal reading at regular intervals at idle RPM**	Burned or leaking valve.	Replace the valve.
 17762	**Indicator drops to zero as engine RPM is increased**	Exhaust system is restricted.	Clear exhaust system.
 17763	**Indicator holds steady at 41–54 kPa (12–16 in. Hg) (1) Drops back to zero (2) and back to about 71 kPa (21 in. Hg) (3) as the throttle is engaged and released**	Possible piston ring leak (Check the compression)	Repair or replace as needed.

Engine Fault Quick Reference Chart

This chart correlates with the fault list of the diagnostic tool. After displaying the faults stored in an ECM, the fault can be referenced on this chart for possible causes and checks to fix the problem. The single circuit diagrams in Section 3A correlate most of these faults with the sensor circuit schematics to help locate wiring problems.

MerCruiser PCM Fault List

MerCruiser ECM/PCM Fault List

NOTE: *All of the following faults are determined by the calibration of the ECM/PCM. Not all faults are used on each engine. This information is accurate as of the date of printing. Fault information is subject to change at any time.*

Use the diagnostic tools to collect fault messages, and use the following chart to interpret the faults and their possible causes.

12-Volt Connector Tool, PCM/ECM Wake-up	91-889675A01
2- to 4-Pin Harness Adapter	84-822560A12
Adapter Harness	84-822560A13
Male-to-Male 10-Pin Adapter	84-892452A01
CAN 1 Diagnostic Cable	84-892663
Computer Diagnostic System (CDS)	Order through SPX
Breakout Box	SPX P/N MM-46225
Terminal Test Probe Kit	SPX P/N MM-46523

ECM/PCM Fault List Information

NOTE: *All of the following are determined by the calibration of the ECM/PCM. Upgrading the calibration can result in changes to these settings.*

FAULT CONDITIONS

Most faults can be detected with the engine running, or with the key on and engine off. However, some faults require the presence of engine RPM, and cannot be detected with the key on but the engine off. Examples of this type of fault are EST (cylinders 1 through 8) shorted circuit and all injector faults (fuel and direct).

Some faults are only detected with the key on and engine off. Examples of the type of fault are EST (cylinders 1 through 8) open circuit.

In addition, some faults are programmed to ignore certain engine speeds. For example, the low block pressure sensor fault (sea pump pressure on a MerCruiser sterndrive) is typically not enabled until enough load has been achieved to develop a reasonable amount of water pressure. Therefore, this fault will not be set at idle.

Faults also take a certain time to set. The time it takes to set a fault varies greatly and can also vary with engine RPM. Faults generally set faster at higher engine speed.

STICKY AND NON-STICKY FAULTS

All faults are classified as either sticky or non-sticky. Sticky means that the fault, once set, will continue to show up as active, even if the circuit or problem has corrected itself. A key switch cycle is required to reset a sticky fault.

A non-sticky fault is a fault that will change its status from active to inactive without requiring a key switch cycle.

The CDS diagnostic tool will continue to display a sticky fault as active even though the cause of the fault has been corrected. Cycle the key to reset all faults if there is difficulty correcting a fault.

DEFAULT SENSOR VALUES

Default sensor values are preprogrammed amounts used by the PCM to calculate fuel and ignition values, when the sensor in question has exceeded its preprogrammed diagnostic limits. Default sensor values typically are used when the sensor has a circuit high or circuit low fault.

Most temperature sensors default to 0 °C (32 °F). This can be verified by unplugging the sensor in question and watching the data stream value with the CDS.

Most pressure sensors default to a preprogrammed number also. MAP sensors usually default to 70 kPa (20.7 in. Hg). This can be verified by unplugging the sensor in question and watching the data stream value. Other pressure sensors will have their own default values which may be determined as described previously.

MerCruiser ECM/PCM Fault List Table Columns

FAULT

The "Fault #" is a number given to the fault for quick reference only.

CDS FAULT MESSAGE

This is how the fault would appear on the CDS screen.

DDT FAULT STATUS MESSAGE

This is how the fault would appear on the DDT screen.

ICON/HORN/GUARDIAN COLUMN

NOTE: Each box contains three pieces of information, each of which corresponds to the reference number in front of it. For example, all items preceded by "♠-" give the system view icon, all items preceded by "♥-" give the warning horn condition, and all information preceded by "♦- " gives the percentage of power available from the engine guardian.

♠- SYSTEM VIEW ICON

Depending on the gauge package, warning icons and fault messages appear on the dash mounted gauges. Generally, an alarm is displayed on the gauge as a bell icon. This icon indicates that a fault has occurred.

♥- WARNING HORN SIGNALS

Most faults will cause the warning horn circuit to activate. How the warning horn activates depends on how serious the problem is. There are five warning horn states:

- None. The horn is silent
- Caution. The horn signal varies with product line and calibration. Minimal guardian.
- Warning. The horn signal varies with product line and calibration.
- Severe. The horn beeps constantly.
- Critical. The horn beeps constantly and guardian will be at forced idle.

♦- ENGINE GUARDIAN

Almost every fault will cause the Guardian program (within the PCM) to become active. The amount of Guardian protection is expressed as a percentage. The higher the percentage, the more power the engine is allowed to produce. If available power (on the CDS or DDT) is 100%, then Guardian is not currently active and the engine is capable of producing full power. On a DTS engine, Guardian closes the ETC to reduce engine power. Non-DTS engines reduce engine power by changing injector and ignition operation.

Guardian is always accompanied by another fault or faults that actually caused the Guardian to become active. The more severe the fault, the more the Guardian reduces available power. A small problem, such as a non-critical sensor going circuit high or circuit low, will result in available power of 90% depending on product line. A severe problem such as low oil pressure or a DTS shift or throttle actuator failing will result in forced idle which is usually displayed as 5–6% available power. Several minor faults occurring at the same time will cause the PCM to treat the faults as a more severe situation.

FAULT EXPLANATION

Fault Explanation gives the most probable reasons for the fault occurring.

POSSIBLE ROOT CAUSE

The possible root cause is the most likely area or part that would cause the fault. Time can be saved by checking these areas first to find the source of the problem.

MerCruiser ECM/PCM Fault List Table

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
1	Battery Voltage High	BAT VOLTS HI	♠-Bell ♥- Critical ♦- Varies	Battery voltage above allowable threshold. The further threshold is exceeded, the more Guardian reduces power.	Alternator. Alternator sense wire.
2	Battery Voltage Low	BAT VOLTS LO	♠-Bell ♥- Critical ♦- Varies	Battery voltage below allowable threshold. Poor connections. The further threshold is exceeded, the more Guardian reduces power.	Alternator. Belt slipping. Defective battery (shorted cells). Too much electrical load. Clean power fuse and battery connections.
3	Sea Pump Pressure is Low	BLK PSI LO	♠-Bell ♥- Critical ♦-Varies	Water pressure in engine block low. Guardian is active. Variable power limit depends on block pressure, port and starboard coolant temperature, and RPM.	Blockage at gearcase inlets. Failed water pump. Failed water tube. Leak between block and sensor. Sensor bad but not open or short.
5	ETC Loss of Control	ETC CONTROL	♠-Bell ♥-Critical ♦-5%	Feedback from ETC indicates actual throttle blade position does not match ERC position.	Faulty ETC; check TPS voltage readings with CDS. Check connection to ETC. Faulty ERC.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
6	ETC Sticking	ETC STICKING	♠-Bell ♥-Critical ♦-5%	Throttle blade not responding to ETC. Blade is stuck or obstructed.	ETC failed. Obstruction in throttle bore. Wiring problem.
9	Guardian Strategy	GUARDIAN	♠-Bell ♥-Critical ♦-Varies	Guardian is trying to protect engine by reducing power.	Check for other faults. The Guardian is a result of other faults. Failed sensor.
10	Knock Sensor 1	KNK SNSR1	♠-Bell ♥-Warning ♦-90%	The knock sensor is expected to sense a minimum amount of vibration. Too little of a signal will cause this fault. Too much and the knock control becomes active.	Failed sensor. Bad wiring. Poor mounting.
11	Knock Sensor 2	KNK SNSR2	♠-Bell ♥-Warning ♦-90%	The knock sensor is expected to sense a minimum amount of vibration. Too little of a signal will cause this fault. Too much and the knock control becomes active.	Failed sensor. Bad wiring. Poor mounting.
12	Oil Pressure Low	LOW OIL PSI STR	♠-Bell ♥-Critical ♦-Varies	Oil pressure low. Guardian is active. Variable power limit depends on RPM.	Low oil level. Blockage in oil system. Sensor is bad but not open or short. Sensor is open or short.
15	MAP Sensor Circuit High	MAP INPUT HI	♠-None ♥-Warning ♦-90%	MAP circuit shorted. Airflow calculation is no longer valid. Power limit is active. Fueling level is a straight lookup based on demand (or TPI) and RPM.	Wiring problem. Sensor problem.
16	MAP Sensor Circuit Low	MAP INPUT LO	♠-None ♥-Warning ♦-90%	MAP circuit open. Airflow calculation is no longer valid. Power limit is active. Fueling level is a straight lookup based on demand (or TPI) and RPM.	Wiring problem. Sensor problem.
17	MAP Sensor Idle Fault	MAP IDLE ERR	♠-None ♥-None ♦-100%	The engine is expected to pull some vacuum on the inlet at idle. If there is no difference in PSI drop from key on to running, the MAP sensor may be bad or airflow disrupted in the intake system.	MAP sensor failed. Throttle bore missing or oversized.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
19	Overspeed	OVERSPEED	♠-Bell ♥-Critical ♦-100%	Recommended RPM range exceeded. First, horn sounds. Second, cylinders stop firing. Third, more cylinders stop firing. Typically next fault is Overspeed1 which causes power limit.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.
21	ECT Overheat	ECT OVRHT	♠-Bell ♥-Critical ♦-Varies	1. Water temperature in head high. Guardian is active. Variable power limit depends on block pressure, port and starboard coolant temperature, and RPM. 2. Engine coolant sensor exceeds a specified threshold.	Blockage at water inlets. Failed or weak sea pump. Blockage in engine. Sensor out of specification.
22	Warning Horn Output	HORN OUTPUT	♠-Bell ♥-Off ♦-100%	Warning horn in boat not operating. No audible alarm will be heard in event of engine malfunction.	Horn failed or missing. Horn not connected. Horn circuit open.
36	Sea Pump Pressure Circuit High	BLK PSI CKT HI	♠-Bell ♥-Warning ♦-90%	Block pressure sensor circuit shorted.	Wiring problem. Sensor problem.
37	Sea Pump Pressure Circuit Low	BLK PSI CKT LO	♠-Bell ♥-Warning ♦-90%	Block pressure sensor circuit is open.	Wiring problem. Sensor problem.
39	Manifold Air Temp Circuit High	MAT CKT HI	♠-Bell ♥-Warning ♦-90%	Air temperature sensor circuit open. Airflow calculation is using the default temperature.	Wiring problem. Sensor problem.
40	Manifold Air Temp Circuit Low	MAT CKT LO	♠-Bell ♥-Warning ♦-90%	Air temperature sensor circuit shorted. Airflow calculation is using the default temperature.	Wiring problem. Sensor problem.
43	EST 1 Open Circuit	EST1 OPEN	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only with the key on and engine off.	Wiring problem. Coil problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
44	EST 1 Shorted Circuit	EST1 SHORT	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only with engine running	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
45	EST 2 Open Circuit	EST2 OPEN	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
46	EST 2 Shorted Circuit	EST2 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
47	EST 3 Open Circuit	EST3 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
48	EST 3 Shorted Circuit	EST3 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
49	EST 4 Open Circuit	EST4 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
50	EST 4 Shorted Circuit	EST4 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
51	EST 5 Open Circuit	EST5 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
52	EST 5 Shorted Circuit	EST5 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
53	EST 6 Open Circuit	EST6 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
54	EST 6 Shorted Circuit	EST6 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
55	EST 7 Open Circuit	EST7 OPEN	♠-Bell ♥-Warning or Caution ♦-90%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
56	EST 7 Shorted Circuit	EST7 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
57	EST 8 Open Circuit	EST8 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
58	EST 8 Shorted Circuit	EST8 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
59	Fuel Injector 1 Open Circuit	FINJ1 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
60	Fuel Injector 1 Shorted Circuit	FINJ1 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
61	Fuel Injector 2 Open Circuit	FINJ2 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
62	Fuel Injector 2 Shorted Circuit	FINJ2 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
63	Fuel Injector 3 Open Circuit	FINJ3 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
64	Fuel Injector 3 Shorted Circuit	FINJ3 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
65	Fuel Injector 4 Open Circuit	FINJ4 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
66	Fuel Injector 4 Shorted Circuit	FINJ4 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
67	Fuel Injector 5 Open Circuit	FINJ5 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
68	Fuel Injector 5 Shorted Circuit	FINJ5 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
69	Fuel Injector 6 Open Circuit	FINJ6 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
70	Fuel Injector 6 Shorted Circuit	FINJ6 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
71	Fuel Injector 7 Open Circuit	FINJ7 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
72	Fuel Injector 7 Shorted Circuit	FINJ7 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
73	Fuel Injector 8 Open Circuit	FINJ8 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
74	Fuel Injector 8 Shorted Circuit	FINJ8 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
75	Fuel Level 1 Circuit High	FUEL LVL CKT HI	♠-None ♥-Off ♦-100%	Fuel level sensor circuit open. This is primary fuel tank if two tanks are used.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
76	Fuel Level 1 Circuit Low	FUEL LVL CKT LO	♠-None ♥-Off ♦-100%	Fuel level sensor circuit shorted. This is primary fuel tank if two tanks are used.	Wiring problem. Sensor problem.
77	Camshaf t Sensor Fault	CAM SNSR	♠-Bell ♥-Warning or Caution ♦-90%	Cam position sensor circuit is faulty. Fuel and ignition strategies will be modified.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
80	Main Power Relay Output	MPRLY OUTPUT	♠-Bell ♥-Off ♦-100%	Key switch +12v and driver power do not agree within calibrated limits.	Low battery voltage is the typical problem. Open coil on the relay.
81	Main Power Relay Backfeed	MPRLY BACKFEED	♠-Bell ♥-Off ♦-100%	Unintended voltage supplied to ECU. Fault declared if voltage regulator in ECU is off, but ECU senses voltage on driver power.	Wiring problem. Relay problem.
84	Oil Pressure Circuit High	OIL PSI CKT HI	♠-Bell ♥-Warning or Caution ♦-90%	Oil pressure sensor circuit shorted.	Wiring problem. Sensor problem.
85	Oil Pressure Circuit Low	OIL PSI CKT LO	♠-Bell ♥-Warning or Caution ♦-90%	Oil pressure sensor circuit open.	Wiring problem. Sensor problem.
89	Oil Temperature Circuit High	OIL TEMP CKT HI	♠-None ♥-Off ♦-100%	Oil temperature sensor circuit open.	Wiring problem. Sensor problem.
93	Pitot Pressure Circuit High	PITOT CKT HI	♠-None ♥-Off ♦-100%	Pitot pressure sensor (used for boat speed) circuit shorted.	Wiring problem. Sensor problem.
94	Pitot Pressure Circuit Low	PITOT CKT LO	♠-None ♥-Off ♦-100%	Pitot pressure sensor (used for boat speed) circuit open.	Wiring problem. Sensor problem.
101	CAN Circuit Fault 1	CAN ERR1	♠-Bell ♥-Severe ♦-90%	CAN bus circuit damaged or faulty	Wiring problem on the CAN 2 (primary control data) system. CAN bus resistor missing.
102	CAN Circuit Fault 2	CAN ERR2	♠-Bell ♥-Caution ♦-90%	CAN bus	Wiring problem on the CAN 3 system.
103	CAN Circuit Fault 3	CAN ERR3	♠-Bell ♥-Severe ♦-90%	CAN bus	Wiring problem on the CAN 1 (redundant control data) system.
104	Lake/ Sea Temp Circuit High	SEA TMP CKT HI	♠-None ♥-Off ♦-100%	Boat mounted water temperature sensor circuit open.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
105	Lake/ Sea Temp Circuit Low	SEA TMP CKT LO	♠-None ♥-Off ♦-100%	Boat mounted water temperature sensor circuit shorted.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
106	Shift Actuator Driver Overtemp	SHIFT DRV OVRTMP	♠-Bell ♥-Caution ♦-100%	Shift actuator driver (within PCM) temperature high.	Wiring problem. Shift actuator faulty. Binding linkage.
107	Shift Actuator Feedback High	SHIFT POS CKT HI	♠-Bell ♥-Warning ♦-90%	Shift position sensor circuit faulty.	Wiring problem. Sensor problem.
108	Shift Actuator Feedback Low	SHIFT POS CKT LO	♠-Bell ♥-Warning ♦-90%	Shift position sensor circuit faulty.	Wiring problem. Sensor problem.
109	Shift Actuator No Adapt	SHIFT NO ADAPT	♠-None ♥-Off ♦-100%	Actuator stalled but not within a valid range.	Check linkage. Shift actuator faulty.
110	Shift Position Switch Fault	SHIFT SWITCH	♠-Bell ♥-Critical ♦-5%	Switch indicates neutral at high speed and high loads. Neutral rational.	Wiring problem. Switch faulty. Check linkage.
111	ECT Circuit High	ECT TMP CKT HI	♠-Bell ♥-Warning ♦-90%	Engine coolant temperature sensor circuit open.	Wiring problem. Sensor problem.
112	ECT Circuit Low	ECT TMP CKT LO	♠-Bell ♥-Warning ♦-90%	Engine coolant temperature sensor circuit shorted.	Wiring problem. Sensor problem.
117	Start Solenoid Output	START SOL	♠-Bell ♥-Off ♦-100%	Open circuit to or insufficient current draw on start relay.	Wiring problem between ECM and start relay. Faulty solenoid.
118	Steering Position Circuit High	STEER CKT HI	♠-None ♥-Off ♦-100%	Steering sensor circuit shorted.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
119	Steering Position Circuit Low	STEER CKT LO	♠-None ♥-Off ♦-100%	Steering sensor circuit open.	Wiring problem. Sensor problem.
120	TPS 1 Circuit High	TPI1 CKT HI	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit shorted.	Wiring problem. Faulty sensor inside of ETC.
121	TPS 1 Circuit Low	TPI1 CKT LO	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit open.	Wiring problem. Faulty sensor inside of ETC.
122	TPS 1 Range High	TPI1 RANGE HI	♠-Bell ♥-Warning ♦-90%	TPI above the normal expected range.	Faulty sensors inside of ETC.
123	TPS 1 Range Low	TPI1 RANGE LO	♠-Bell ♥-Warning ♦-90%	TPI below the normal expected range.	Faulty sensors inside of ETC.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
124	TPS 1 No Adapt	TPI1 NO ADAPT	♠-None ♥-Warning ♦-100%	Outside valid range when trying to adapt. Adapt occurs when exiting crank on way to run.	Faulty sensors inside of ETC.
125	TPS 2 Circuit High	TPI2 CKT HI	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit shorted.	Wiring problem. Faulty sensor inside of ETC.
126	TPS 2 Circuit Low	TPI2 CKT LO	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit open.	Wiring problem. Faulty sensor inside of ETC.
127	TPS 2 Range High	TPI2 RANGE HI	♠-Bell ♥-Warning ♦-90%	TPI above the normal expected range.	Faulty sensors inside of ETC.
128	TPS 2 Range Low	TPI2 RANGE LO	♠-Bell ♥-Warning ♦-90%	TPI below the normal expected range.	Faulty sensors inside of ETC.
129	TPS 2 No Adapt	TPI2 NO ADAPT	♠-Bell ♥-Warning ♦-100%	Outside valid range when trying to adapt. Adapt occurs when exiting crank on way to run.	Faulty sensors inside of ETC.
130	Trim Sensor Circuit High	TRIM CKT HI	♠-None ♥-Off ♦-100%	Trim sensor circuit shorted.	Wiring problem. Sensor problem.
131	Trim Sensor Circuit Low	TRIM CKT LO	♠-None ♥-Off ♦-100%	Trim sensor circuit open.	Wiring problem. Sensor problem.
132	Crank Position Sensor Fault	VR SNSR STR	♠-Bell ♥-Warning ♦-90%	Variable reluctance sensor (crank position sensor).	Crankshaft sensor. Noise on circuit. With this failure, engine will not run. Wiring problem. Sensor problem.
133	Power 1 Volts (5VDC) Low	5 VDC PWR LO	♠-Bell or None ♥-Caution ♦-100%	Supplies power to all engine sensors (+5v).	Excessive current draw on the +5 VDC circuit. Circuit or sensor shorted to ground.
134	Overspeed 1	OVERSPEED 1	♠-None ♥-Critical ♦-100%	Level 1 of overspeed exceeded.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.
135	Overspeed 2	OVERSPEED 2	♠-None ♥-Critical ♦-5%	Level 2 of overspeed exceeded.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
138	ECM Memory Fault	ECM MEMORY ERR	♠-Bell ♥-Critical ♦-5%	ECM memory is corrupted.	ECM faulty.
148	ESC and Neutral Switch Position Fault	ESC-NS POS DIFF	♠-Bell ♥-Critical ♦-5%	ESC actuator's determination of its position and neutral switch position do not agree.	Harness connection to neutral switch faulty, or faulty neutral switch.
149	ETC Idle Range Fault	ETC IDLE RANGE	♠-Bell ♥-Caution ♦-100%	ETC out of range for the idle position.	Wiring problem. Debris in ETC. Faulty ETC. Air leak in induction system.
150	Dual Engine CAN Circuit Fault	DUAL CAN SOH	♠-Bell ♥-Critical ♦-5%	Communication between System View and PCM has been lost. Discrepancy between CAN 1 and CAN 2.	Wiring problem CAN1 & CAN2. Lost terminator connection.
151	Fuel Pump Relay Circuit	FUEL PUMP RLY CKT	♠-Bell ♥-Warning ♦-90%	Open circuit in fuel pump relay circuit. This fault cannot detect any problems in fuel pump circuit.	Wiring problem. Connector problem. Relay problem.
152	IAC Output	IAC OUTPUT	♠-Bell ♥-Caution ♦-90%	Open circuit to IAC.	Wiring problem. Connector problem. Bad IAC.
153	Drive Lube Bottle Low	LOW DRIVE LUBE	♠-Bell ♥-Severe ♦-100%	Drive lube switch goes active	Drive lube low. Faulty low lube switch. Transmission temp high.
158	Port EMCT Circuit High	PRT EMCT CKT HI	♠-Bell ♥-Warning ♦-90%	Port exhaust manifold temperature circuit open.	Wiring problem. Sensor problem.
159	Port EMCT Circuit Low	PRT EMCT CKT LO	♠-Bell ♥-Warning ♦-90%	Port exhaust manifold temperature circuit shorted.	Wiring problem. Sensor problem.
160	Port EMCT Overheat	PRT EMCT OVRHT	♠-Bell ♥-Critical ♦-Varies	Port exhaust manifold temperature high.	Cooling problem.
163	CAN Circuit Fault 5	CAN ERR5	♠-Bell ♥-Critical ♦-3%	CAN bus.	Wiring problem on the CAN system.
176	Shift Actuator Position Sensor Fault	ESC-ERC POS DIFF	♠-Bell ♥-Critical ♦-5%	ESC actuator's determination of its position and commanded position do not agree.	Worn linkage. Faulty ESC. Faulty ERC.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
177	Starboard EMCT Circuit High	STB EMCT CKT HI	♠-Bell ♥-Warning ♦-90%	Starboard exhaust manifold temperature circuit open.	Wiring problem. Sensor problem.
178	Starboard EMCT Circuit Low	STB EMCT CKT LO	♠-Bell ♥-Warning ♦-90%	Starboard exhaust manifold temperature circuit shorted.	Wiring problem. Sensor problem.
179	Starboard EMCT Overheat	STB EMCT OVRHT	♠-Bell ♥-Critical ♦-Varies	Starboard exhaust manifold temperature high.	Cooling problem.
180	MAP/TPI Difference Fault	MAP DIFF ERR	♠-Bell ♥-Critical ♦-5%	Both TPIs are functioning, but MAP sensor calculations do not agree. Suspect MAP sensor to be faulty.	MAP sensor outside of expected operating range. Abnormal airflow in intake.
181	TPI Sensors (All)	ALL TPS ERR	♠-Bell ♥-Critical ♦-5%	MAP does not agree with either TPI. Power off the ETC.	Wiring problem to ETC. Sensor problem.
182	TPS 1 Difference Fault	TPI1 DIFF ERR	♠-Bell ♥-Warning ♦-90%	MAP sensor range = TPI2, but TPI1 does not agree.	Wiring problem to ETC. Sensor problem.
183	TPS 2 Difference Fault	TPI2 DIFF ERR	♠-Bell ♥-Warning ♦-90%	MAP sensor range = TPI1, but TPI2 does not agree.	Wiring problem to ETC. Sensor problem.
184	Trim Down Relay Output	TRIM DOWN SOL	♥-Warning ♦-100%	Trim down circuit faulty.	Wiring problem. Faulty relay coil.
185	Trim Up Relay Output	TRIM UP SOL	♠-Bell ♥-Warning ♦-100%	Trim up circuit faulty.	Wiring problem. Faulty relay coil.
186	CAN Circuit Fault 7	CAN ERR7	♠-Bell ♥-Caution ♦-100%	CAN bus.	Problem on the CAN system.
187	CAN Circuit Fault 8	CAN ERR8	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.
188	Primary Demand to Redundant Diff	DEMAND DIFF	♠-Bell ♥-Critical ♦-5%	CAN1 not equal to CAN2 cross check failure.	Faulty pots in ERC.
189	Demand Cross Check Difference	XCHK DEMAND DIFF	♠-Bell ♥-Critical ♦-5%	Command module not equal to PCM cross check of demand value.	Incorrect positions used when configuring levers at command module, faulty command module or ECM.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
190	Shift Cross Check Difference	XCHK SHIFT DIFF	♠-Bell ♥-Critical ♦-5%	Command module not equal to PCM cross check of shift position.	Incorrect positions used when configuring levers at command module, faulty command module or ECM.
191	Fuel Level 2 Circuit High	FUEL LVL2 CKT HI	♠-None ♥-Off ♦-100%	Secondary boat mounted fuel tank sensor circuit open.	Wiring problem. Sensor problem.
192	Fuel Level 2 Circuit Low	FUEL LVL2 CKT LO	♠-None ♥-Off ♦-100%	Secondary boat-mounted fuel tank sensor circuit shorted.	Wiring problem. Sensor problem.
193	Shift Anticipate Switch Fault	SHIFT ANT SWITCH	♠-Bell ♥-Critical Engine dies	Shift anticipate (interrupt) switch active at incorrect time.	Wiring problem. Mechanical linkage problem. Faulty shift switch.
194	ESC Timeout Fault	ESC TIMEOUT	♠-Bell ♥-Warning ♦-90%	Shift actuator cannot reach desired position, or actuator moves back and forth when it should be steady.	Bad shift actuator or shift actuator position sensor. Maladjusted shift cable. Excess friction in shift cable or drive.
196	Transmission Overheat	TRANS OVERHEAT	♠-Bell ♥-Severe ♦-100%	Transmission temperature high.	Not available at time of print
209	Driver Power 2 Low	DRIVER POWER LO	Not available at time of print.	Supplies power to all drivers (+12v).	Faulty or low battery condition.
210	Overspeed in Neutral	NEUTRAL OVERSPD	♠-Bell ♥-Critical ♦-100%	Allowable overspeed limit in neutral exceeded.	Bad shift switch. Engine exceeded specified RPM in neutral.
211	Overspeed in Reverse	REVERSE OVERSPD	♠-Bell ♥-Critical ♦-100%	Allowable overspeed limit in reverse exceeded.	Engine exceeded specified RPM limit in reverse gear.
212	SmartStart Aborted	SMART START ERR	♠-Bell ♥-Caution ♦-100%	No engine RPM detected, no starter engagement.	Starter failed to engage. Weak battery. Open circuit to start solenoid. CPS circuit problem.
215	CAN Circuit Fault 9	CAN ERR9	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.
216	CAN Circuit Fault 10	CAN ERR10	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
217	Power 2 (5 VDC) Volts Low	5 VDC PWR 2 LO	♠-Bell ♥-Caution ♦-100%	Supplies power to all SmartCraft sensors (+5v).	Excessive current draw on the +5 VDC circuit. Paddle wheel harness shorted. SmartCraft connector corroded.
218	Helm ADC Check	HELM ADC ERR	♠-Bell ♥-Critical ♦-5%	Discrepancy between DTS Command Module and PCM.	Wrong DTS Command Module for engine model. Bad DTS Command Module. Incorrect PCM hardware.
219	ESC Loss of Control	ESC CONTROL LOST	♠-Bell ♥-Caution ♦-5%	ESC in gear position other than commanded by ERC.	Potentiometers in electronic shift actuator are questionable. Wiring to actuator could be bad.
226	CAN Circuit Fault 11	CAN ERR11	♠-Bell ♥-Critical ♦-5%	CAN bus	Communication problem on the CAN system.
227	Hydraulic Shift Pressure Sensor A Circuit Low	HSHIFT PSI A LO	♠-None ♥-Off ♦-100%	Pressure Sensor A open. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
228	Hydraulic Shift Pressure Sensor A Circuit High	HSHIFT PSI A HI	♠-None ♥-Off ♦-100%	Pressure Sensor A shorted. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
229	Hydraulic Shift Pressure Sensor A Circuit Undefined	HSHIFT PSI A	♠-Bell ♥-Critical ♦-100%	Pressure Sensor A detects that the transmission is not in neutral or in-gear. This fault will also detect if the transmission is in-gear while attempting to start engine.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.
230	Hydraulic Shift Pressure Sensor B Circuit Low	HSHIFT PSI B LO	♠-None ♥-Off ♦-100%	Pressure Sensor B open. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
231	Hydraulic Shift Pressure Sensor B Circuit High	HSHIFT PSI B HI	♠-None ♥-Off ♦-100%	Pressure Sensor B shorted. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
232	Hydraulic Shift Pressure Sensor B Undefined	HSHIFT PSI B	♠-Bell ♥-Critical ♦-100%	Pressure Sensor B detects that the transmission is not in neutral or in-gear. This fault will also detect if the transmission is in-gear while attempting to start engine.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.
233	Hydraulic Shift System Fault	HSHIFT ERROR	♠-Bell ♥-Critical ♦-100%	Both pressure sensors determine an in-gear state.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.
234	Hydraulic Shift System Pressure too High	HSHIFT PSI HI	♠-Bell ♥-Critical ♦-5%	The pressure sensor determine that the fluid pressure in the transmission is too high.	Dirty filter in transmission, high transmission fluid, sticky valve in transmission, wiring problem, sensor problem.
235	Hydraulic Shift System Position Fault	HSHIFT POS DIFF	♠-Bell ♥-Critical ♦-5%	The pressure sensors determine that the solenoid being activated is incorrect.	Helm not set correctly, the wiring for the solenoids are switched, the wiring for the pressure sensors are switch, wiring problem, sensor problem.
236	Emergency Stop Activated	STOP CKT ACTIVE	♠-Bell ♥-Warning ♦-100%	Emergency stop performed.	Reattach lanyard and restart engine.

PCM Frequently Asked Questions

What is a circuit (CKT) high or low fault?

A circuit fault can be due to an open or short condition, which may include a damaged sensor, a connector or wiring harness problem. The ECM has detected that its sensor input has either gone to a high or low input condition. Depending on the sensor type used, a low may not necessarily indicate a short circuit or a high may not necessarily indicate an open circuit condition. In either case there is a problem detected by the ECM.

What is a STR (Strategy)?

A strategy is a method of control that involves ECM reaction to various engine conditions normally based on inputs from various sensors or switches. Example: If a critical engine sensor, like the engine coolant sensor or oil pressure sensor is disconnected, the ECM control strategy may only allow the engine to operate at some reduced level of engine power in an attempt to protect the engine from damage.

What is a TPI/TPS High or Low Range fault?

The TPI/TPS sensor diagnostic fault calibration within the ECM, can alert the technician of a fault condition where the sensor is above or below the normal operating range. This fault is not the same as an open or short circuit fault. Possible causes may be loose or misadjusted throttle linkage and excessive wear on components connected to the TPI/TPS.

Why do we use the loaded volts lead on some pinpoint tests?

The lead provides a current draw on the circuit, allowing us to diagnose instances where a single strand of wire may still be connected. The single strand will allow the circuit to pass the traditional ohms test but may not be able to pass enough current.

How can I switch between the data screens and the service manual?

Open the service manuals by clicking on the book icon and selecting the correct manual. Use the ALT and TAB buttons simultaneously to toggle between the CDS program and the service manual program.

Why do some faults take longer to set than others?

The ECM has individual fault calibrations for every sensor or device that is controlled by the ECM. The way in which the faults are calibrated will appear to the user as fast or slower responding fault messages.

What is an (MPR) Main Power Relay Output Fault?

If the battery voltage available at the engine is less than 7.5 volts, for example, during cranking, the MPR may not close or even remain closed during cranking, resulting in no spark, no injector activity, or no voltage to the electric fuel pump. The ECM decides the MPR output circuit is at fault and sets a fault code, which is stored in the Freeze Frame buffer. An MPR output fault can either be one of two types: the voltage being transferred across its relay contacts is below allowable limits, the relay coil itself is faulty, or its connection to the relay coil socket or the associated harness wire is open circuit. Other typical problems that may cause MPR output faults:

- Incorrect battery type and capacity
- Use of a deep cycle battery as the primary cranking battery
- Loose or corroded battery cable connections (at the battery or the engine)
- Discharged battery (shorted or dead cells)
- Faulty battery switch contacts or loose connections
- Short extension wires from battery switches that have excessive amounts of shrink sleeve partially covering the ring terminals
- Incorrectly sized battery cables if longer battery cables are required
- 12-volt power buss-bar connection problem

What's wrong when I see a PWR1 or 5VDC Power Low fault?

The ECM has detected a problem with its internal 5-volt power supply. Usually this results from a short circuit between the +5VDC wiring to ground. Any external engine sensors or accessory SmartCraft sensors, if improperly connected, can result in overloading the 5 volt supply.

NOTE: *If the 5VDC supply is low enough the engine may be impossible to even start.*

Typical problems include:

- SmartCraft accessory harness missing the protective waterproof cap and pins are corroding
- Damaged paddlewheel sensor has allowed the sensor wiring to be exposed to water

Service Hint: While monitoring the +5 volt supply reading, disconnect the main SmartCraft accessory harness to see if the voltage problem is corrected. If not, continue disconnecting engine sensors one at a time until problem is corrected. Repair or replace the faulty components.

NOTE: *After repairs are completed make sure to clear fault history in order to clear any faults created during the testing process.*

Why does an EST or ECM Trigger Open not register as a fault when the engine is running?

The ECM signal that triggers the ignition coil driver can only be detected as an open circuit when there is no engine speed. Likewise, a short circuit can only be detected with engine speed.

What are MAP Diff or TPI Diff errors?

ECM system strategies allow the MAP pressure readings to be correlated to typical TPI readings for any given RPM and boat load. The ECM calculates the differences between nominal MAP readings and the current TPI readings. If there are any differences outside the typical operating range, then MAP differences or TPI difference errors are stored in the ECM Freeze Frame history buffers. Either the MAP sensor or TPI may be unplugged, intermittent or having a harness connection problem resulting in these errors.

What is a MAP Idle Check or MAP Idle Err?

The engine is expected to pull a little vacuum on the inlet at idle. If there is no pressure difference between the ambient barometer at key-up to the pressure (MAP) in the intake, the throttle bore must be missing, a very large air leak exists, a possible fault in the wiring harness exists, or the sensor has failed.

What do Overspeed Fault and Engine Guardian Fault indicate?

On an EFI engine, overspeed and engine guardian are used as methods for controlling engine power and protecting the engine from mechanical damage. For example: If the engine block temperature is running too warm but not at a critical level, the PCM/ECM analyzes all sensor inputs and engine load. Once the calculations are made, then the Engine Guardian strategy determines what appropriate engine RPM can be achieved under those given operating conditions and reduces RPM based on the sensor inputs and the current engine load. If the engine temperature reaches a critical condition, then the only remaining option is to sound the overheat alarm and reduce power to a minimum level. Overheat seconds are only logged when the critical overheat temperature is reached and the alarm is sounded.

What is a MPRLY REQ (Main Power Relay Request) in the Freeze Frame buffer?

The PCM/ECM can request the main power relay be turned on for various reasons. For example: When the key switch is turned to the ‘ON’ position, the PCM/ECM requests the fuel pump also to be turned on. During the time the relay is active, a number code is displayed in the Freeze Frame buffer, which represents that the relay was on for various reasons. Depending on the requirements at the time a fault was recorded, seeing a number for MPRLY REQ only indicates the relay was on and nothing more. If the number displayed is zero, the relay was off at the time the fault was recorded. **Do not interpret this number as an indication the number of times the relay was faulty. If the number is greater than zero then the relay was turned on.**

Why is the engine slowing down and how do I know if Engine Guardian is active?

View the parameter called AVAILABLE PWR% on the Data List Screen. If everything is normal, 100% will be displayed. If 100% is displayed then Engine Guardian is not responsible for the reduction in RPM. Anything less than 100% indicates a problem and Guardian is or soon will be active. For example, look at the various engine temperature sensors to see if anything seems warmer than normal.

NOTE: *As a general rule consider the normal operating temperature to be the same as the operating specification of the thermostats installed on the engine.*

I see the following faults: OIL LVL IN(ckt) HI, FUEL LVL IN(ckt) HI or SEA TEMP IN (ckt) HI. Is there a problem and how can I eliminate these faults?

If no paddlewheel (contains the lake or sea temp sensor), or SmartCraft fuel or oil level sensors installed, the ECM will record and store these fault codesby default if these faults can be ignored, if the sensors are not installed. If the engine is equipped with any of these sensors, this fault indicates that a sensor is faulty or the wiring connected to the sensor has a connection problem.

What is a good tool to use to diagnose boat wiring problems?

A key switch test harness with horn will quickly help you isolate a problem.

Why can I not get the active data screen to list any values?

Typically it is one of three reasons.

- First, do you have the correct engine model selected? This is usually indicated by a yellow flashing SmartComms logo in the bottom display bar.
- Second, the SmartComms box may need re-booted. Disconnect the engine communication cable from the box, let it power down and then reattach the cable.
- Third, you may have to restart the Mercury Marine Computer Diagnostic System program. Follow the instructions listed under question "What should I do if the system locks up?"

What should I do if the CDS system locks up?

First, try closing the program using the exit button on the top right hand side of the screen. If the exit button is not active, move the curser over the Start button tool bar. Right click and select Task Manager from the pop-up menu. One by one, select all the tasks and click on the End Task button. Once all the tasks are stopped, shut the computer down and re-start the window.

Why do I have to connect the ohm meter leads together at the start of the pinpoint tests?

This step is used to verify operation of the meter and continuity of the meter leads. If the reading is higher than expected, the system will inform you about defective meter leads. Normal readings are less than 0.7 ohms.

Why do the pinpoint tests ask me if I have started the engine?

To properly run the pinpoint test, the diagnostic system needs to determine if the engine is capable of running. If a "No Start" condition exists, the software will use this information in some tests to make diagnostic decisions. The software allows the technician to continue past the Start Engine prompt if desired. The question is asked to determine if a "No Start" condition exists or if the technician elected to NOT start the engine.

Why am I not able to get past the Ohmmeter verification screen during the pinpoint tests?

The CDS system is receiving higher than normal readings from the VOM meter. First, check the meter leads on the VOM meter. Connect the two leads together with the meter set to ohms and verify the resistance reading. The reading must be below 0.7 ohms to continue with the test. If the reading is above normal, wiggle the leads for better contact and clean the surfaces if necessary. Second, verify the battery condition inside the VOM. A marginal battery will cause the resistance reading to be above normal, try a new battery.

Why am I not able to get the VOM meter to communicate with the CDS system?

Check that the PCMCIA card is installed into the computer correctly and the VOM meter communication cable connections are correct. Remember to press and hold the REL% button on the meter to activate the communication port each time you turn on the meter or the meter will not communicate with the CDS computer.

I have multiple engines on the boat, but do not have the ability to view data from all the engines from a single connection with the CDS system. Why?

Some models do not have the ECMs connected together into a single system; the CDS must be connected to these engines individually. Typically, GM-based fuel injection systems and CAN-based system may allow the single connection point.

How does the cylinder-misfire test work?

The cylinder misfire test increases the fuel delivery for the selected cylinder when under idle control (throttle closed). When the throttle has opened far enough for the engine to leave idle control (between 1% and 9%, depending on model), the cylinder misfire test will turn off the fuel injector for the selected cylinder. On some models (usually large 4-strokes), this may not be noticeable when idling. If the test is performed at higher speeds and loads, the results will be clearer.

Why do I need to run the cylinder misfire test at a higher RPM or under load?

While cylinder misfire test can be performed under any RPM and load condition, test results may not be noticeable at idle speed on all models. Results may be clearer when performed under high load and/or higher RPM conditions.

Why do I need to disconnect power to both fuel pumps?

In addition to the high-pressure fuel pump, MerCruiser models usually have a boost pump that pressurizes the system to around 10 psi. If you only disconnect the high pressure pump, the fuel injectors are fired at 10 psi and will still deliver a considerable amount of fuel into the cylinders.

NOTE: *If the fuel pump connectors are difficult to reach, removing the fuel pump relay will disable both fuel pumps. Disregard the resulting Fuel Pump Relay fault code if the relay is removed.*

How do I perform a fuel injector test on a MerCruiser PCM 555 system?

After disabling the fuel pump, a PCM 555 MerCruiser fuel system can only be tested by selecting the appropriate "bank" of injectors. On MerCruiser models equipped with the ECM555 processor, the fuel injectors are controlled in "banks" of two to four injectors, depending on the engine. 2005 and newer GM Small Block V-8 engines with an ECM555 processor will have 4 injector selections available on the Active Test screen in the Toolbox. These newer engines have 4 injector drivers to fire the injectors in pairs. Older GM Small Block V-8 engines that are 2004 and older have 2 injector drivers that fire injectors in banks of 4. The 4.3L V-6 has two banks of three injectors. Selecting cylinder "1" on these models will effect "bank 1." Selecting cylinder "2" on these models will effect "bank 2," and so on.

How do I test a MerCruiser ECM 555 system with one ignition coil?

An ECM555 MerCruiser ignition system has one ignition coil and an HVS distributor. To test this system, the coil wire must be removed from the HVS distributor and a spark plug installed on end of the coil wire. Ground the spark plug to the engine block and then perform the test while watching for spark across the gap. Since there is only one coil the system will operate the same way for any cylinder selected.

How do I configure a digital throttle and shift helm station?

Refer to the following help topics for step-by-step procedures:

- How to Perform DTS Vessel Configuration
- How to Perform DTS Lever Adaptation

How do I calibrate the cursor/screen on my Panasonic touch-screen PC's?

Go to the Windows "Start" button, then click: SETTINGS, CONTROL PANEL, MOUSE, TOUCH SCREEN, and CALIBRATION. Follow the prompts to calibrate the touch screen.

What does IAT and MAT stand for?

IAT stands for intake air temperature, and MAT stands for manifold air temperature. Some systems include an IAT or MAT sensor.

What does DTS stand for?

DTS stands for digital throttle and shift. This type system is found on late-model engines. DTS requires engine and helm station configuration.

Refer to the following help topics for step-by-step procedures:

- How to Perform DTS Vessel Configuration
- How to Perform DTS Lever Adaptation

Why is my laptop battery charge low after long-term storage?

Laptop batteries are designed for regular and frequent (daily or weekly) use, not for extended storage periods. For optimal battery performance, you should discharge the battery regularly through normal use and recharge it as necessary. You can also leave the laptop connected to the 110-volt power supply to keep the battery fully charged.

Dealers who choose to store the computer for extended periods should be aware of the following facts:

- Long-term storage weakens the battery cell lining. The longer the storage period, the weaker the lining becomes.
- The battery cells will eventually begin to break down, resulting in reduced charging capacity. You will likely notice that the charge capacity progressively falls off: 90 percent, 80 percent, etc.

- If you have no other choice than to store the battery for extended lengths of time, charge the battery to approximately 30 percent and no more.

IMPORTANT: Do NOT allow the battery get to an absolute zero charge or it may become difficult to bring back up to full charge. (This caution only applies to a storage situation where the battery drop to zero and stays there for a week or more.)

- The battery will always leak current during its storage period. The rate of leakage depends upon many factors such as temperature, humidity, and elevation. In ideal conditions, you can probably expect a battery with a 30 percent charge to store for a month or so.

Why am I having trouble zeroing the ohms reading on my multimeter?

The multimeter will not properly zero on the ohms scale if the internal battery is low. If you cannot get past the meter zero screen in Pinpoint Diagnostics, verify the internal battery is good and make sure the leads are not visibly damaged or otherwise defective. To optimize battery life, remember to turn the multimeter power off when it's not in use. The multimeter also has a "sleep" mode that powers down the screen after 30 minutes of inactivity. This mode allows the instrument to continue to acquire data with minimal power requirements. However, over a period of time, these minimal power requirements will draw the battery down.

NOTE: *if the battery is low, voltmeter readings may be innacurate.*

Why does the DMT 2004 voltmeter report high readings for the 5-volt reference signal?

Occasionally, we receive reports of high readings on the 5-volt reference signal when using the DMT 2004 voltmeter. Higher than normal reference voltage readings are NOT typical of PCMs or ECMs used on Mercury products. Refer to the CDS Toolbox **DATA ITEMS** and compare the PCM/ECM POWER 1 reading to the voltmeter reading. Allowing for resistance in the wires and test leads, the readings should be within two to three tenths of each other. Wide-spread differences are usually the result of a low 9-volt battery inside the DMT 2004 voltmeter. In many cases, technicians do not notice the low battery (BAT) indicator, flashing on the meter display. This indicator begins to flash when battery voltage drops below a acceptable level. The flashing BAT icon appears on the center, left side of the display.

To optimize battery life, remember to turn the multimeter power off when it's not in use. The multimeter also has a sleep mode that powers down the screen after 30 minutes of inactivity. This mode allows the instrument to continue to acquire data with minimal power requirements. However, over a period of time, these minimal power requirements will draw the battery down.

NOTE: *if the battery is low, voltmeter readings may be innacurate.*

What is the difference between a sticky and non-sticky fault?

All faults for ECM555, PCM555, PCM03 and DTS command modules are classified as "sticky" or "non-sticky."

- A **sticky fault**, once set, continues to show up as active – even if the circuit or problem has corrected itself. You must perform a key switch cycle to reset a sticky fault.
- A **non-sticky fault** changes its status from "active" to "inactive" without requiring a key switch cycle.

Note that the CDS will continue to display sticky faults as active, even though the cause of the fault has been corrected. Cycle the key to reset all faults if you are having difficulty correcting a fault.

What is Engine Guardian?

On DTS engines, Guardian closes the electronic throttle control (DTC) to reduce engine power. This operation is very smooth and not usually noticeable to the operator. The engine seems to be down on power and does not shake, vibrate or buck.

Non-DTS engines reduce engine power by changing injector and ignition operation which is quite obvious to the operator. The engine shakes, vibrates and "bucks" at the guardian limit, similar to the rev-limit function but at lower RPM.

What does Fault Seconds information tell me?

Fault Seconds is list of data, available for ECM555, PCM555 and PCM03 command modules on 2001 and newer engines. The Fault Seconds list shows the first 23 possible faults for these processors. Not all of these faults are applicable to all product lines. For example, "air compressor overheat" fault seconds only apply to Optimax models. These 23 faults are hard-coded into the processor and, if any fault seconds are logged, all 23 faults will be displayed with applicable seconds listed by each one.

NOTE: *The Port Head Overheat reading applies to V6 outboards only. The Starboard Head Overheat reading applies to V6 outboards and is also the "ECT" reading on MerCruiser models. Cylinder Head and Block Overheat Fault Seconds for all Verado models are NOT logged in this list.*

How do I tell the difference between 2004, 2005, and 2006 and newer DTS systems?

Model Year 2004 Systems:

- Display version number 0 in the **Command Module City ID grid** on the System Information screen.
- Require you to manually select their current locations before CDS establishes communication with the system. Once communication is established, you can assign one of two locations, then calibrate the control handles.

Model Year 2005 Systems:

- Display version number "60" thru "69" in the **Command Module City ID grid** on the System Information screen.
- Allow the CDS system to establish communication by auto-detecting their current location. Communication allows you to assign one of twelve locations using the **Vessel Configuration** tab on the System Information screen. Once the location is set, you must switch to DTS Handle Configuration. DTS Handle Configuration allows you to calibrate the control handles with the command module.

Model Year 2006 and Newer Systems:

- Display version number "70" and higher in the **Command Module City ID grid** on the System Information screen.
- Allow the CDS system to establish communication by auto-detecting their current location. Communication allows you to assign one of twelve locations using the Vessel Configuration tab on the System Information screen. Once the location is set, you must switch to DTS Handle Configuration. DTS Handle Configuration allows you to calibrate the control handles with the command module.

NOTE: *Mismatched engine PCMs and Command Modules will interfere with system communication which prevents proper system configuration.*

For more information, refer to **How to View DTS Command Module City ID Locations"**

What does the Unit of Measurement Counts stand for?

Analog-Digital (AD) counts (sometimes referred to as raw counts), refer to a method of measuring a sensor signal in steps called "counts." Counts are used on 2-wire and 3- wire sensors that, depending upon the specific engine application, monitor conditions such as fuel level, trim, and remote oil tank level. The typical count range for a sensor is between 0 and 1023 counts (actually 1024 separate counts). In each case, 0 is the lowest possible reading and 1023 is the highest possible reading. The AD count signal can be related to sensor voltage. 0 counts equals 0 volts and 1023 counts equals 5.0 volts. Everything in between is proportional and can be calculated if so desired) for diagnostic purposes.

While counts can be directly related to sensor voltage, they are NOT directly related to a quantity of fuel, angle of trim or oil tank level. Rather, counts indicate the relative condition of a sensor signal. A sensor circuit showing 0 counts or 1023 counts is either shorted or open and is not functioning correctly, and should trigger the appropriate "Circuit Lo or Circuit Hi" fault. The exact count measurement that sets a "circuit high" condition can vary from calibration to calibration, but is usually around 1015. 10 counts usually sets a "circuit low" condition.

NOTE:

Some PCMs are programmed to communicate with the CDS to display some sensors in a range of 0 to 255 (256 separate counts), which is 1/4 of the value of the 0 to 1023 sensor range (256 x 4 = 1024).

How do I detect a COM port setting for my multimeter?

1. Insert your PCMCIA card into the card slot on the CDS host computer and listen for the an audible tone that indicates Windows has recognized the card.
2. Click the Setup and Utilities tab in CDS.
3. Click the Multimeter Available box to turn the Multimeter on in CDS.
4. Click the Detect button for the COM Port setting.
5. Follow the prompts on the screen asking you to connect your multimeter to the PC and turn the meter ON.
6. Click the Start button.
7. After the COM Port has been detected, click the green check box.
8. Your COM Port has been successfully configured and you can use your Multimeter in CDS.
9. NOTE:

NOTE: *The PCMCIA card must be installed before running the CDS application. This allows CDS to detect the card and the multimeter to properly function.*

What is a trim delta test?

Trim Delta is a new active test for MerCruiser DTS (digital throttle shift) Bravo Engines with MY06 or newer calibrations. Trim Delta allows the technician to set the maximum amount of difference (delta) between the trim settings of all drives on a multiple engine boat. The higher the setting, the greater the difference (delta) between the drive trim angles.

Excessive Delta can cause damage to the Steering Tie Bar connecting the drives together. By Default, Trim Delta is turned OFF and must be "enabled" by the boat manufacturer (or technician). Trim Delta must be individually configured for each engine (PCM) in the boat.

What is shadow mode?

Shadow mode is used when three or four engines are controlled with two helm stations.

- **Three engine system:** The center engine is controlled by the average throttle position output of the two outside engines. If only one of the outside engines is running, shadow mode mimics the throttle position output of that outside engine.
- **Four engine system: T**he starboard and port inner engines will mimic the output of the corresponding outer engines. See "How to Perform Shadow Mode DTS Vessel Configuration" for more information.

Why don't my Freeze Frame buffers and FPC (Fuel per Cylinder) data items display correctly?

If you experience trouble reading FPC or Freeze Frame buffers, make sure you have selected the correct model year engine/calibration. If you have selected a MY05 (or earlier) calibration, and you are connected to a MY06 calibration, you will not be able to read the FPC Data Item or Freeze Frame Buffers.

If you have selected a MY06 (or newer) calibration, and are connected to a MY05 (or earlier) calibration, you will not be able to read the FPC data item or Freeze Frame Buffers. Generic engine selections have been created to allow you to quickly try either MY selection if the MY of the calibration is not self-evident. The model year of the calibration can be determined by selecting the "Calibration and System Info" Icon in the CDS Toolbox and reading the calibration of the PCM from that screen.

Why do MerCruiser engines with Hurth Electronically controlled transmissions have fewer active tests?

Due to changes in the PCM software on MerCruiser engines with the Hurth Electronically controlled transmission, the following active tests will not function:

1. Electric Shift
2. Throttle (engine running)
3. Electric Throttle (engine not running)
4. Start Relay

What is AutoSync?

AutoSync is a new active test for all DTS (Digital Throttle Shift) engines with MY06 or newer calibrations. AutoSync allows the technician to enable or disable the AutoSync function. When disabled, the engines will not attempt to remain synchronized. AutoSync must be individually configured for each engine (PCM) in the boat. The default setting is ENABLED.

DTS Command Module Faults

NOTE: *Not all codes may be turned on in each DTS command module calibration.*

NOTE: *The "X" refers to engine 1 or engine 2. A System View can display faults from two engines. DTS 1 faults are from the starboard engine, while DTS 2 faults are from the port engine.*

Computer Diagnostic System (CDS)	Order through SPX

Can 1 Diagnostic Cable	84-892663

Fault #	System View (v3.44) Text	CDS Text	Fault Explanation	Pin #	Color Code (Single/Stbd)	Color Code (Dual/Port)
1	DTS X Fault 1 Warning Device Open	Warning Horn Output	The command module has detected a problem with its warning horn circuit.	24	Tan/Light Blue	Tan/Light Blue
2	DTS X Fault 2 Lever 1 Fault 2	Lever 1 High Resolution Circuit High or Low	The circuit is open or shorted between the command module and the ERC, or the pot in the ERC is open or shorted.	5	Blue/Yellow	Blue/Red
3	DTS X Fault 3 Lever 1 Fault 3	Lever 1 Increasing Circuit High or Low	The circuit is open or shorted between the command module and the ERC, or the pot in the ERC is open or shorted.	17	Pink/Brown	Pink/Yellow
4	DTS X Fault 4 Lever 1 Fault 4	Lever 1 Decreasing Circuit High or Low	The circuit is open or shorted between the command module and the ERC, or the pot in the ERC is open or shorted.	4	Pink/Red	Pink/Dark Blue
5	DTS X Fault 5 Lever 1 Fault 5	Lever 1 High Resolution Difference Error	When compared to the other 2 pots, the ERC's high resolution pot is reading wrong. Faulty pot or circuit.	5	Blue/Yellow	Blue/Red
6	DTS X Fault 6 Lever 1 Fault 6	Lever 1 Increasing Circuit Difference Error	When compared to the other 2 pots, the ERC's increasing pot is reading wrong. Faulty pot or circuit.	17	Pink/Brown	Pink/Yellow
7	DTS X Fault 7 Lever 1 Fault 7	Lever 1 Decreasing Circuit Difference Error	When compared to the other 2 pots, the ERC's decreasing pot is reading wrong. Faulty pot or circuit.	4	Pink/Red	Pink/Dark Blue
8	DTS X Fault 8 Lever 1 Fault 8	Lever 1 Multiple Circuit Fault	More than one Lever 1 fault is active. The other faults will be listed individually.			
9	DTS X Fault 9 Lever 2 Fault 9	Lever 2 High Resolution Circuit High or Low	The circuit is open or shorted between the command module and the ERC (or foot throttle), or the pot in the ERC is open or shorted.	16	Green/Yellow	Green/Black
10	DTS X Fault 10 Lever 2 Fault 10	Lever 2 Increasing Circuit High or Low	The circuit is open or shorted between the command module and the ERC (or foot throttle), or the pot in the ERC is open or shorted.	3	Green/Orange	Pink/Orange
11	DTS X Fault 11 Lever 2 Fault 11	Lever 2 Decreasing Circuit High or Low	The circuit is open or shorted between the command module and the ERC (or Foot Throttle), or the pot in the ERC is open or shorted.	15	Green/Red	Green/Blue

Fault #	System View (v3.44) Text	CDS Text	Fault Explanation	Pin #	Color Code (Single/Stbd)	Color Code (Dual/Port)
12	DTS X Fault 12 Lever 2 Fault 12	Lever 2 High Resolution Difference Error	When compared to the other 2 pots, the ERC's (or foot throttle's) high resolution pot is reading wrong. Faulty pot or circuit.	16	Green/Yellow	Green/Black
13	DTS X Fault 13 Lever 2 Fault 13	Lever 2 Increasing Circuit Difference Error	When compared to the other 2 pots, the ERC's (or foot throttle's) increasing pot is reading wrong. Faulty pot or circuit.	3	Green/Orange	Pink/Orange
14	DTS X Fault 14 Lever 2 Fault 14	Lever 2 Decreasing Circuit Difference Error	When compared to the other 2 pots, the ERC's (or foot throttle's) decreasing pot is reading wrong. Faulty pot or circuit.	15	Green/Red	Green/Blue
15	DTS X Fault 15 Lever 2 Fault 15	Lever 2 Multiple Circuit Fault	More than one Lever 2 fault is active. The other faults will be listed individually.			
16	DTS X Fault 16 CAN 2 Fault 16	Primary Control Data Failure (PCM may show CAN Comm Fault Type 1)	The data for control of the ETC and ESC actuators has not been received (on the CAN 2 bus) when expected.	6 & 7	Yellow & Brown in the CAN bus	Yellow & Brown in the CAN bus
17	DTS X Fault 17 CAN 1 Fault 17	Redundant Control Data Failure (PCM may show CAN Comm Fault Type 3)	The backup data for the control of the ETC and ESC actuators has not been received (on the CAN 1 bus) when expected.	8 & 9	White & Blue in the CAN bus	White & Blue in the CAN bus
18	DTS X Fault 18 CAN 1 Fault 18	Medium Speed Engine Data Fault (PCM may show CAN Comm Fault Type 3)	The medium speed engine data (from the PCM) has not been received (on the CAN 1 bus) when expected.[1.]	8 & 9	White & Blue in the CAN bus	White & Blue in the CAN bus
19	DTS X Fault 19 CAN 1 Fault 19	Low Speed Engine Data Fault	The low speed engine data (from the PCM) has not been received (on the CAN 1 bus) when expected.[2.]	8 & 9	White & Blue in the CAN bus	White & Blue in the CAN bus
20	DTS X Fault 20 DTS Fault 20	Multiple Engine Fault	The command module has detected more than 1 engine at the same address (city ID).		Check engine location (in the PCM)	Check engine location (in the PCM)
21	DTS X Fault 21 DTS Fault 21	FailSafe Mode Fault	The command module cannot detect any engines.			

1. The medium speed engine data (updated at a moderate rate) contains information on RPM, fuel flow and pressure, MAP, gear position, speed (pitot and paddle), trim angle, steering, trim tabs, and warning system data.
2. The low speed engine data (updated the slowest) contains information on the engine state, guardian, run time, break-in, fuel level, oil system, cooling system, barometric, battery voltage, depth, and sea temperature data.

Fault #	System View (v3.44) Text	CDS Text	Fault Explanation	Pin #	Color Code (Single/Stbd)	Color Code (Dual/Port)
22	DTS X Fault 22 DTS Fault 22	ETC/ESC Crosscheck Data Failure (PCM may show CAN Circuit Fault 9)[3].	The crosscheck data for control of the ETC and ESC actuators (from the PCM) has not been received when expected.			
23	DTS X Fault 23 DTS Fault 23	TPS% Crosscheck Difference Fault[3].	The PCM and command module are disagreeing on the throttle plate's position.[4].			
24	DTS X Fault 24 DTS Fault 24	Shift% Crosscheck Difference Fault[3].	The PCM and command module are disagreeing on the shift actuator's position.[4].			
25	DTS X Fault 25 DTS Fault 25	Advancing Throttle Fault	RPM data from the PCM (on the CAN 2 bus) has not been received when expected. Used for synchronization. Fastest possible update rate.	6 & 7	Yellow & Brown in the CAN bus	Yellow & Brown in the CAN bus
26	DTS X Fault 26 Bus Voltage Low	CAN Bus Voltage Low	The voltage in the CAN bus (red lead) is less than 8.0 volts. If fault 28 is not present, then check the battery voltage and all of its connections for corrosion, high resistance, and loose connections. If fault 28 is present, follow the instructions for it first.	13 & 14	Red and Black (anything that may cause low voltage from the battery)	Red and Black (anything that may cause low voltage from the battery)
27	DTS X Fault 27 Bus Voltage High	CAN Bus Voltage High	The voltage in the CAN bus (red lead) is greater than 16.0 volts. (Same cause as battery voltage high; check alternator, trolling motor, etc.)	13 & 14	Red and Black (anything that may cause high voltage from the battery)	Red and Black (anything that may cause high voltage from the battery)
28	DTS X Fault 28 Bus Voltage Delta	CAN Bus Voltage below Battery Voltage	The voltage in the CAN bus is less than the battery voltage (as reported by the PCM). Check the DTS command module power circuit for loose connections, corrosion, and high resistance. This fault has priority over fault 26.	13 & 14	Red and Black in the CAN bus, including DTS command module power.	Red and Black in the CAN bus, including DTS command module power.
29	DTS X Fault 29 CAN PWM ADC Missing	CAN PWM ADC Missing[3].	Communication error on the CAN bus.			
30	DTS X Fault 30 CAN PWM ADC Failed	CAN PWM ADC Failed[3].	Communication error on the CAN bus.			

3. A communication error may be caused by unconfigured helms, incorrect calibrations, incorrect termination resistors, as well as various hard wiring problems (corrosion, ground loops, etc.).
4. On these faults, the PCM sends the raw AD counts of the sensor to the command module then calculates the sensor's position and compares it to the PCM's calculated position. If they disagree, the command module sets the appropriate fault.

Fault #	System View (v3.44) Text	CDS Text	Fault Explanation	Pin #	Color Code (Single/Stbd)	Color Code (Dual/Port)
31	DTS X Fault 31 Foot Throttle Button	Foot Throttle Button	Foot throttle enable/ disable button or circuit on the panel mount ERC.	Unknown	Unknown	Unknown
32	DTSX Fault code 32 Single lever mode	Single lever mode	The command module could not complywith a request for a single lever mode (from the CAN-based trackpad.)	Unknown	Unknown	
33	DTS X Fault 33 Cruise interface	Cruise interface	There is a problem with the communication between the Cruise Control device (System Vies of System Tach) Tach) and the command module.	Unknown	Unknown	
34	DTS X Fault 34 Configuration	Not Configured	The command module has not been configured. If this code is not present, the module has been configured, but it may not have been configured correctly for the current	Unknown	Unknown	

Diagrams

Section 3A - Diagrams—Mechanical

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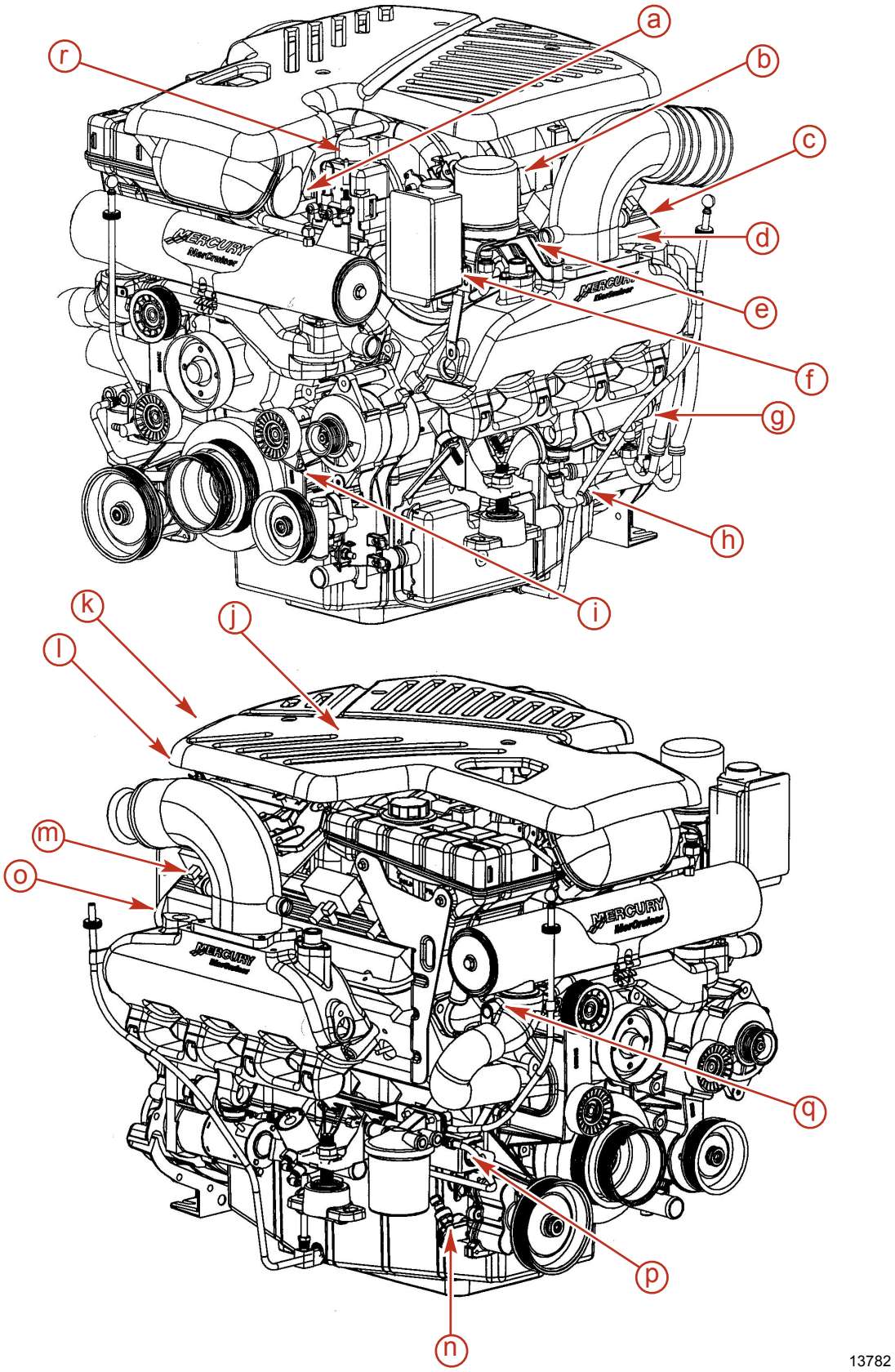
Sensor Locations on the 8.1 Liter (496 CID) Engine



Sensor Locations on the 8.1 Liter (496 cid) Engine

a - Throttle position sensor (TPS)
b - Electronic control module (PCM)
c - Crankshaft position sensor (CPS)
d - Port exhaust manifold coolant temperature sensor (EMCT)
e - Data link connector (DLC)
f - Power steering reservoir
g - Oil pressure sensor
h - Cool fuel pump connector
i - Camshaft position sensor (CMP)
j - Manifold absolute pressure sensor (MAP)
k - Manifold air temperature sensor (MAT)
l - Idle air control valve (IAC)
m - Starboard exhaust manifold coolant temperature sensor (EMCT)
n - Seawater pump pressure sensor—OWXXXXXX serial numbers and above (On power steering and transmission cooler)
o - Seawater pump pressure sensor—OWXXXXXX serial numbers and below
p - Boost fuel pump connector
q - Engine coolant temperature sensor (ECT)
r - Drive lube monitor

Engine Harness

Wiring Color Legend

Wire Label	Wire Color
BLU	Blue
DK BLU	Dark Blue
LT BLU	Light Blue
BLK	Black
GRA or GRY	Gray
GRN	Green
DK GRN	Dark Green
ORN	Orange
PPL or PUR	Purple
RED	Red
TAN	Tan
WHT	White
YEL	Yellow

Wire Splice Description—Mechanical

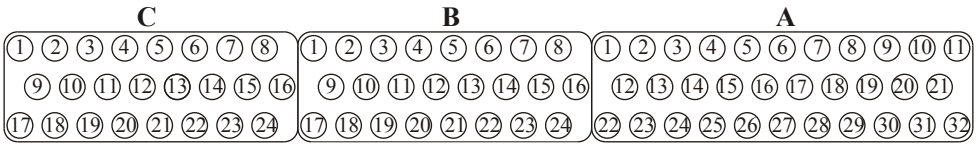
Splice Number	Description
100	5 volt transducer ground
101	5 volt transducer power for sensors
102	Wake line, fused 20 ampere, 12 volt power (key on only)
103	12 volt power, 50 ampere protected
104	Battery ground (–), 12 volt

Splice Number	Description
105	Main power relay (key on only), 12 volt
106	EST return
107	Power to PCM, 12 volt fused
108	Power to the fuel pump and injectors, 12 volt fused
109	5 volt transducer ground
110	12 volt power, 50 ampere protected
111	Fuel pump power from relay
112	Gear position

PCM 555 Pin-out—Mechanical

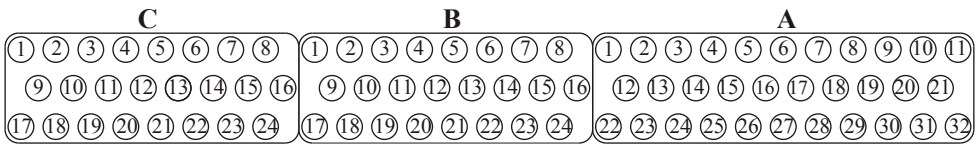
Use this table as a quick reference guide to the pins of the PCM to verify broken pins, what the pins control, and to aid in checking circuit continuity.

NOTE: *This mechanical 10–pin harness is a two-piece harness consisting of a charging and starting harness and a separate EFI harness.*



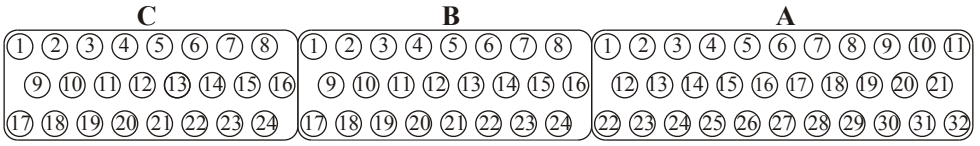
Connector A—Mechanical

Mercury Part Number		**84-863084A1 84-862536A1**
Pin		**Mechanical**
A1	Key-on power (Wakeup)	PNK
A2	Empty	Empty
A3	MAP signal	LT GRN
A4	Oil pressure signal	BLU/BLK
A5	Pitot signal	LT BLU/BLK
A6	Throttle position sensor 1 signal	DK BLU
A7	Empty	Empty
A8	Digital trim signal	ORN/DK BLU
A9	Starboard tab position signal	DK BLU/YEL
A10	Port tab position signal	LT BLU
A11	CAN Line 1 Pos (+)	ORN
A12	Steering position (Smart Transom)	LT BLU/BLK
A13	Seawater temperature signal	YEL/BLK
A14	MAT signal	TAN
A15	ECT signal	YEL
A16	Odd EMCT signal	TAN/WHT
A17	Even EMCTsignal	TAN/BLK
A18	Scan (–)	WHT/PPL
A19	Odd knock sensor 1 (–)	BLK/YEL
A20	Even knock sensor 2 (–)	BLK/WHT
A21	CAN 1 line neg (–)	YEL/WHT
A22	Sender ground	BLK/PNK
A23	Sender power	GRY
A24	Seapump signal	BLU/YEL
A25	Fuel level 2 signal	LT BLU/BLK
A26	Fuel level 1 signal	PNK/BLK
A27	Empty	Empty
A28	Scan (+)	WHT/BLK
A29	Odd knock sensor 1 (+)	BLK/ORN
A30	Even knock sensor 2 (+)	BLK/RED
A31	CAN 2 pos (+)	ORN/DK BLU
A32	CAN 2 neg (–)	YEL/RED



Connector B—Mechanical

Mercury Part Number		84-863084A1 84-862536A1
Pin		Mechanical—10 Pin
B1	EST return	BRN
B2	EST coil 1 trigger	WHT/RED
B3	Paddle wheel signal	GRY/BLK
B4	Main power relay control	PPL
B5	Empty	Empty
B6	CAM sensor signal	PPL/WHT
B7	IAC valve control	BLK/GRN
B8	Empty	Empty
B9	EST coil 5 trigger	WHT/PPL
B10	EST coil 3 trigger	WHT
B11	Fuel pump relay control	GRN
B12	Tachometer	WHT
B13	Empty	Empty
B14	Crankshaft position sensor signal	TAN
B15	Gear position switch signal	BRN
B16	Drive lube monitor or trans oil temp switch	TAN/WHT
B17	MPR output (to PCM)	PNK
B18	MPR output (to PCM)	PNK
B19	Empty	Empty
B20	Fuel injector 4	GRN/YEL
B21	Warning horn	TAN/BLK
B22	Fuel injector 3	GRN/ORN
B23	E-Stop	YEL/BLK
B24	Empty	Empty



Connector C—Mechanical

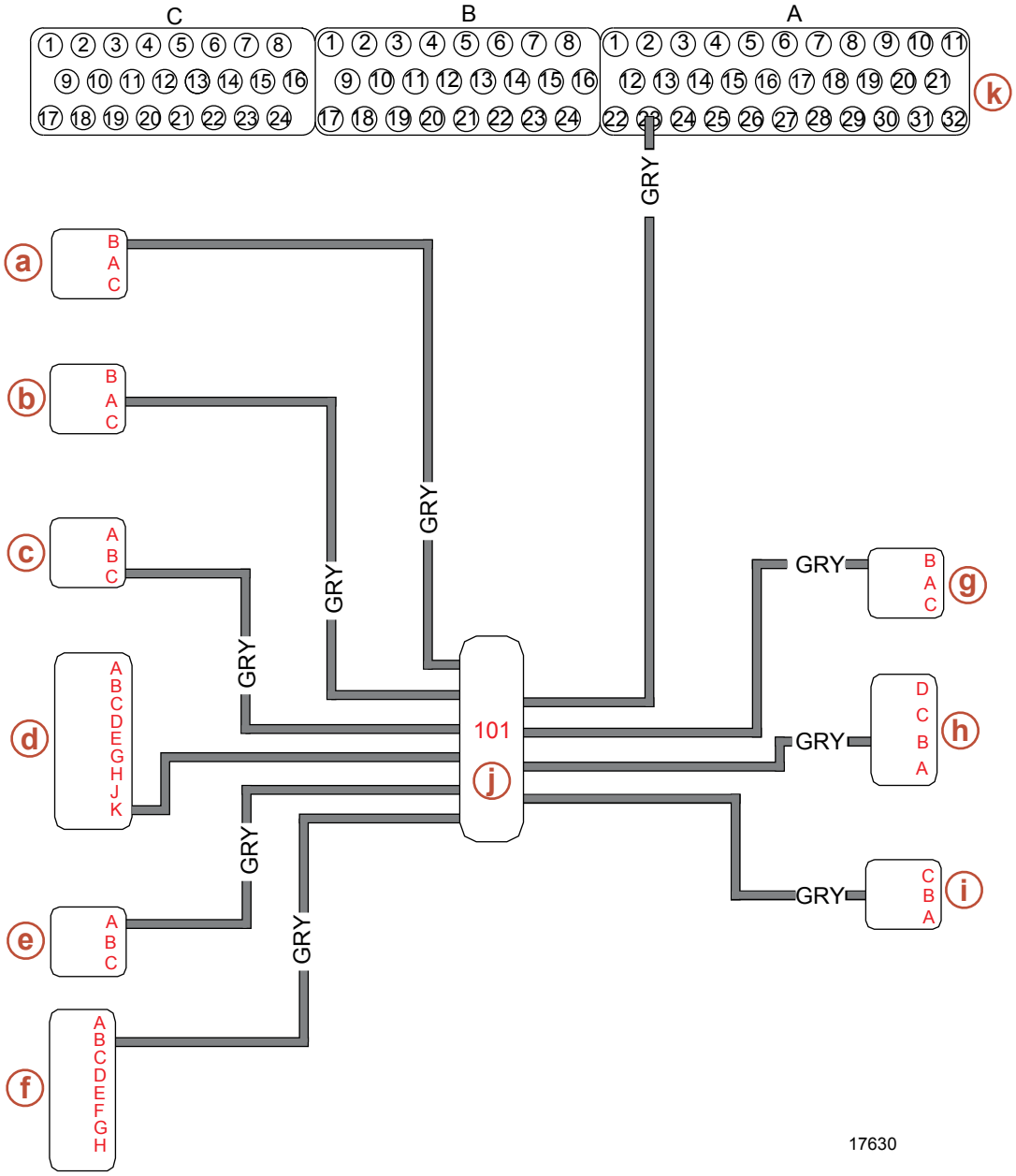
Mercury Part Number		84-863084A1 84-862536A1
Pin		Mechanical
C1	Port Tab up solenoid	LT BLU/RED
C2	Empty	Empty
C3	Fuel Injector 8	GRN/BLK
C4	Empty	Empty
C5	Fuel injector 7	BRN/WHT
C6	Fuel injector 1	LT GRN/BLK
C7	EST coil 4 trigger	WHT/RED
C8	EST coil 2 trigger	WHT/BLK
C9	Starboard Tab up solenoid	LT BLU/BLK
C10	Starboard Tab down	LT GRN/BLK
C11	Fuel injector 2	LT GRN/RED
C12	EST coil 6 trigger	WHT/LT BLU
C13	EST coil 7 trigger	WHT/BLK
C14	EST coil 8 trigger	WHT
C15	Ground	BLK
C16	Ground	BLK
C17	Empty	Empty
C18	Empty	Empty
C19	Port Tab down solenoid	GRN/WHT
C20	Trim down relay control	LT BLU/WHT
C21	Fuel injector 6	GRY/BLK
C22	Trim up relay	DK BLU/WHT
C23	Fuel injector 5	BRN/DK BLU
C24	Ground	BLK

Wiring Diagrams

Wire Harness Connector Socket Identification

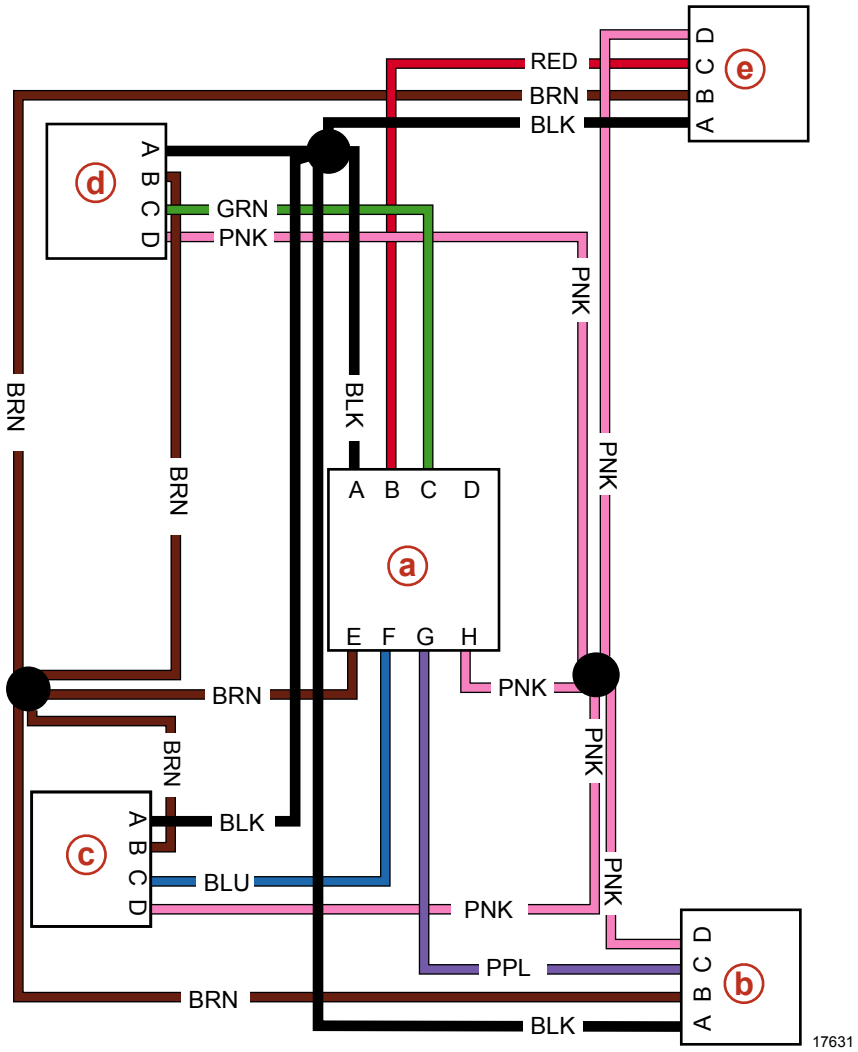
NOTE: *The letters A-B-C near the three multi-pin connectors shown in some wiring diagrams indicate the letter identification of the ECM or PCM wire harness connector sockets. The letter A is for the 32 pin connector and B and C are for the two separate 24 pin connectors.*

5-Volt Sensor Circuit—Mechanical



a - Seawater pump pressure
b - TPS
c - MAP
d - TABS
e - Crankshaft position
f - Smart transom
g - Oil pressure
h - Paddle wheel
i - Camshaft position
j - Splice 101
k - PCM connector A

Coil Harness Circuit

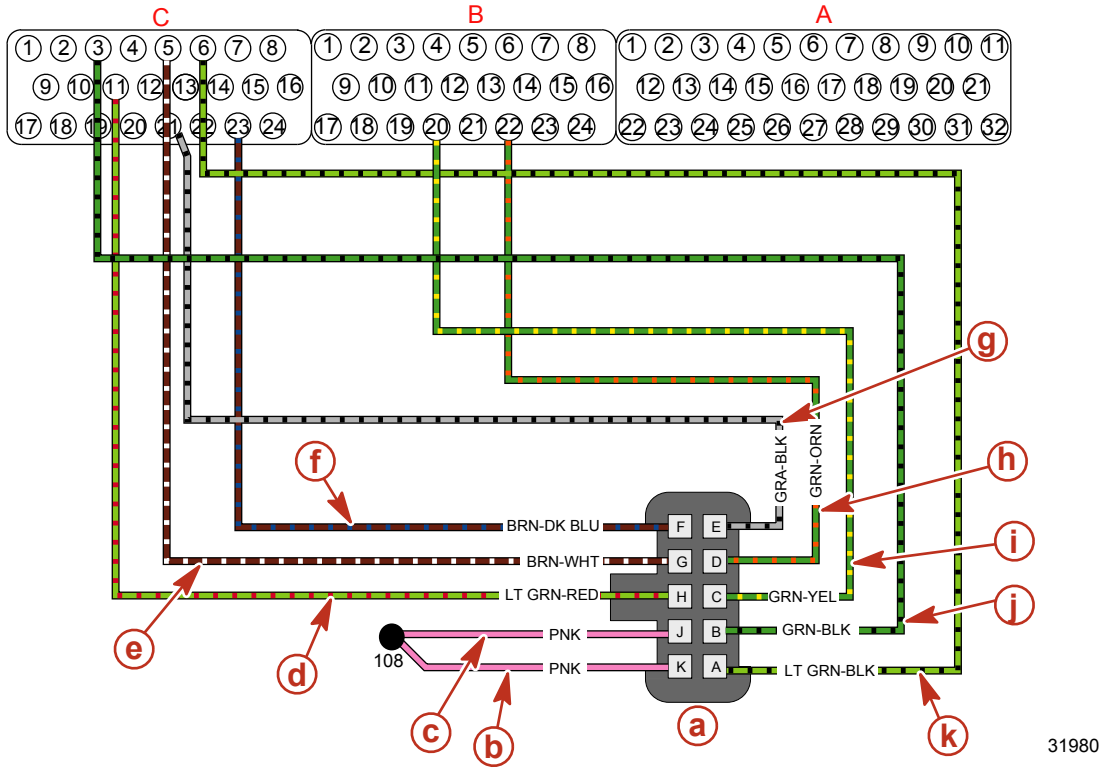


a - Coil harness to engine harness connector
b - 1 and 8 coil connector
c - 3 and 6 coil connector
d - 5 and 4 coil connector
e - 7 and 2 coil connector

There are 2 coil harnesses on the engine, one for each side of the engine. The harnesses are wired identically. The signal wire color for coils 1 and 8 is PPL, coils 3 and 6 is BLU, 5 and 4 wire is GRN, and 7 and 2 is RED The PNK wire is 12 volt power, the BRN wire is EST-return and the BLK wire is ground. If a possible problem is suspected in the ignition system, check for faults once with key ON and once with engine running. An EST Open will only register a fault in a key ON only state and an EST Short will only register with the engine operating.

A malfunction in the coil harness will set the fault of EST 1-8 Open or EST 1-8 Short.

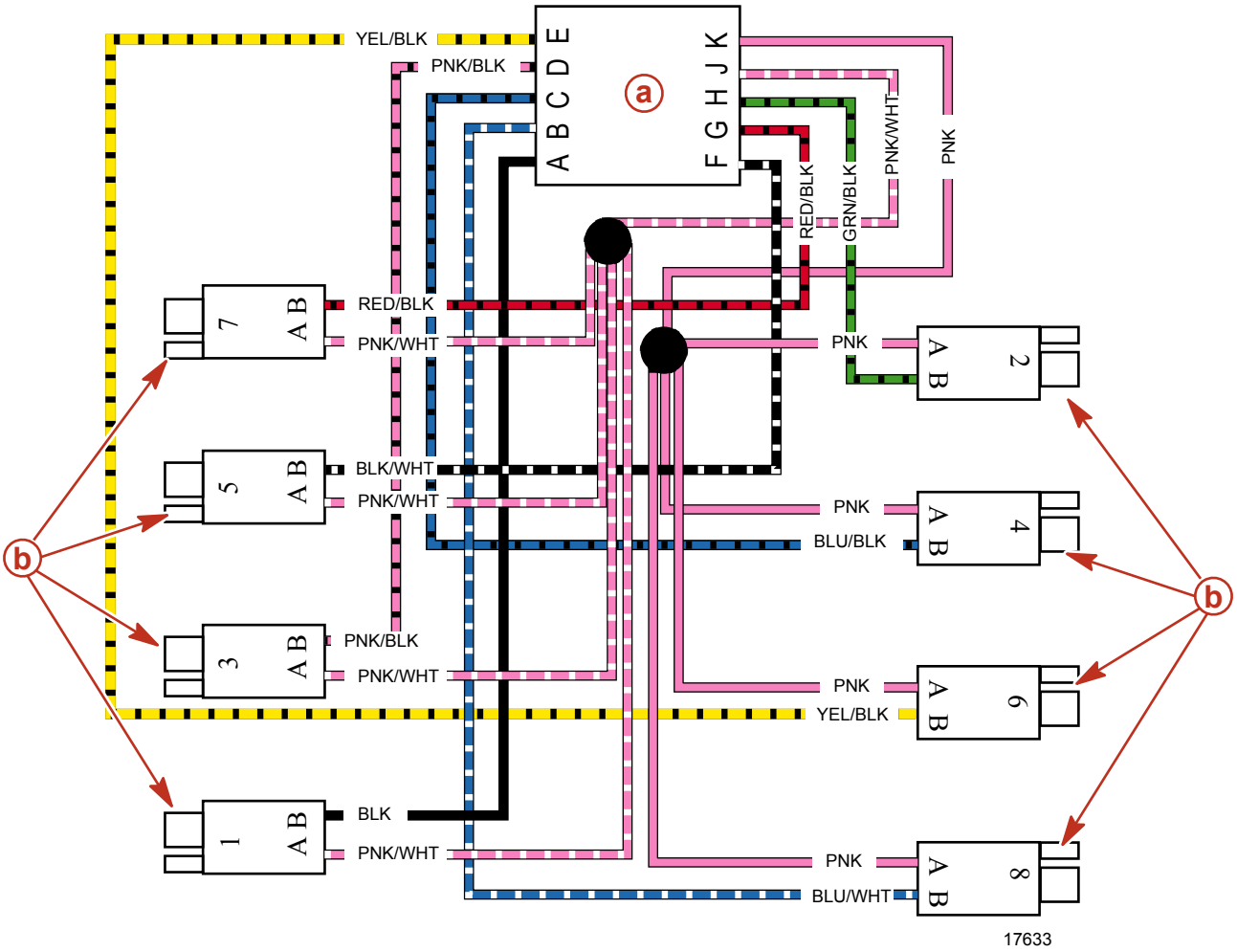
Fuel Injector Circuit (Engine Harness)



a - Engine harness to fuel injector harness connector
b - 12 Volt fused power to injectors (splice 108)
c - 12 Volt fused power to injectors (splice 108)
d - Injector 2
e - Injector 7
f - Injector 5
g - Injector 6
h - Injector 3
i - Injector 4
j - Injector 8
k - Injector 1

The fuel injectors receive fused 12 volt power on pins J and K of the engine harness connector from the splice 108. The PCM signals the injectors to activate by pulling the 12 volt to ground and completing the circuit through the engine harness and injector harness.

Fuel Injector Circuit (Injector Harness)



a - Injector harness to engine harness connector

b - Individual injector connectors

The fuel injectors receive fused 12 V power from splice 108 (pins J and K) on the injector harness. The PCM signals the injector to fire by pulling the 12 V to ground and completing the circuit. The normal resistance value of one injector at 21° C (70° F) is 12.5 ohms.

A malfunction in the fuel injector harness will set the fault of FINJ 1-8 Open or FINJ 1-8 Short.

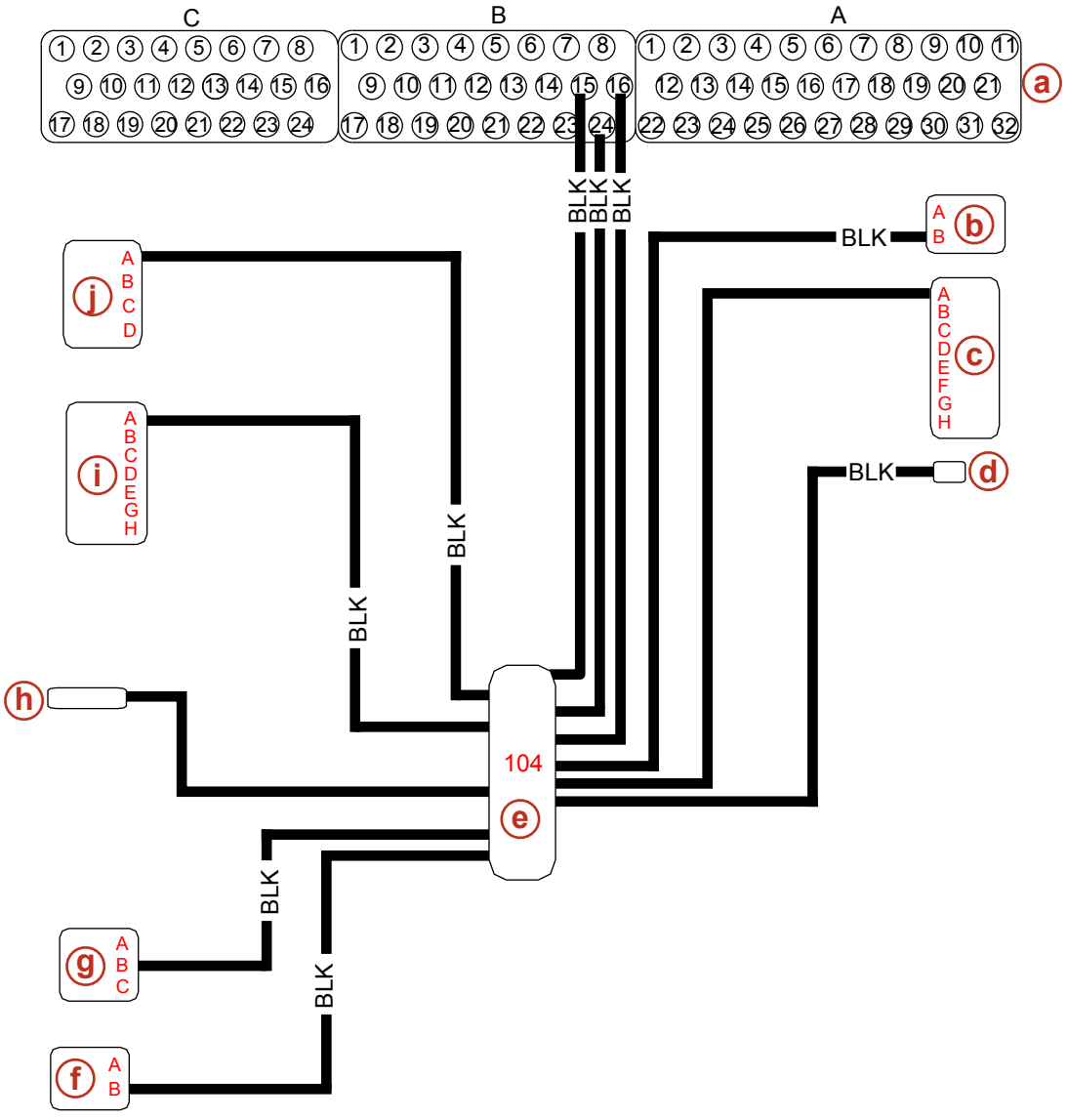
If the fuel injector driver wire has shorted to ground, the scan tool reads Open Sensor, meaning that the fuel injector circuit is full Open.

The scan tool reads Short Injector if a fuel injector has a short circuit.

A 12 V fuel injector power lead with a short circuit will blow the injector fuse E-F; the scan tool will read Bad Fuel Pump Fuse.

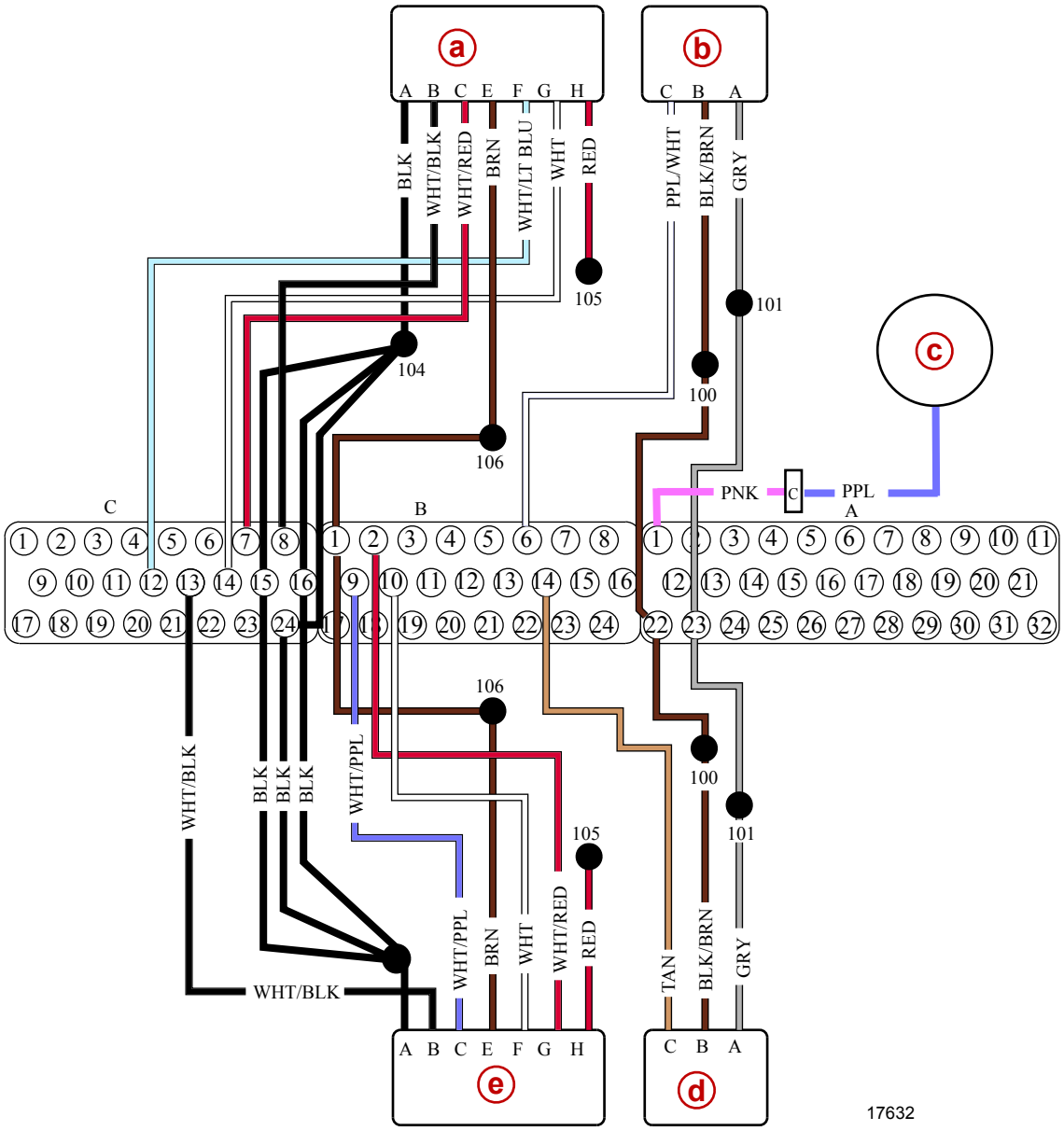
Fuel Injector Number	Wire Colors on Fuel Injector Harness	PCM Pinout
1	BLK	C-6
2	GRN/BLK	C-11
3	PNK/BLK	B-22
4	BLU/BLK	B-20
5	BLK/WHT	C-23
6	YEL/BLK	C-21
7	RED/BLK	C-5
8	BLU/WHT	C-3

Ground Circuit



a - PCM connector
b - Booster fuel pump
c - Even coil
d - Ground
e - Splice 104
f - Cool fuel
g - Multi-engine disconnect
h - Gear lube monitor ground
i - Odd coil
j - Diagnostics

Ignition Circuit



a - Coil trigger—even
b - CAN sensor
c - Key switch
d - Crankshaft position sensor
e - Coil trigger—odd

With initial key ON, 12 V is sent from the battery through the purple lead in the 10-pin harness to the pink lead at engine harness pin C. This is wake up power to the PCM. The PCM powers pin B4 which in turn pulls the MPR low. The MPR supplies power to the coils, through splice 105, and to the engine for ignition.

PCM Pinout	Cylinder	PCM Pinout	Cylinder	PCM Pinout	Cylinder
B2	1	C8	2	B9	5
C7	4	C13	7	C14	8
B10	3	C12	6		

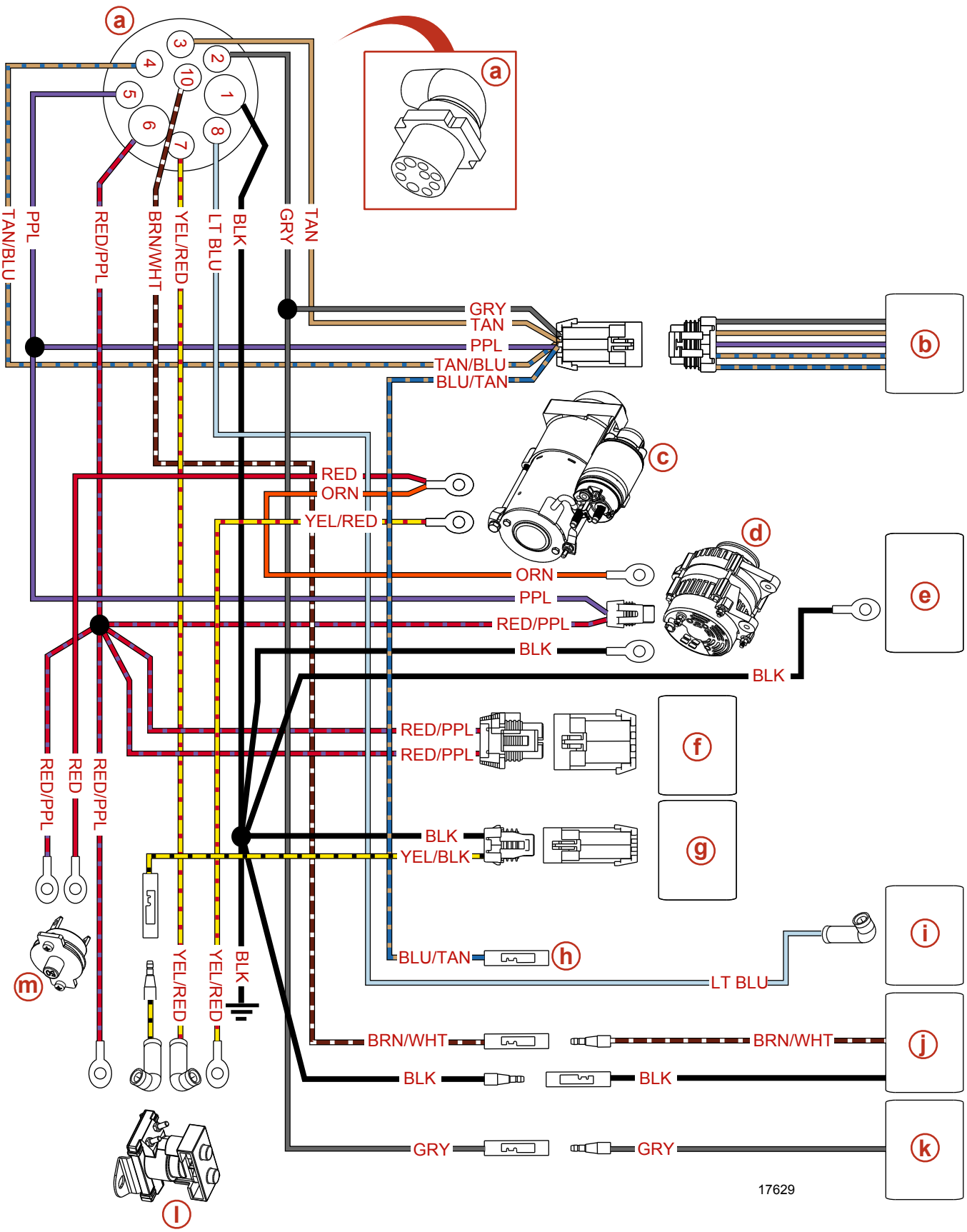
Positive Current Flow

This is a general description of the positive current flow from the battery through the system until the starter motor cranks.

NOTE: *Ensure that all connections are tight and have the required resistance.*

- Battery to the starter solenoid switch on the starter (red battery cable).
- Starter solenoid switch to circuit breaker (red).
- Circuit breaker to wire junction (red/purple).
- Wire junction to wiring harness plug (red/purple) Terminal 6.
- Wiring harness plug to 20 amp fuse (red/purple).
- 20 ampere fuse to the ignition switch terminal B (red/purple). At this point ignition switch is turned to the start position.
- Ignition switch terminal B to terminal S.
- Ignition switch terminal S to neutral start switch (yellow/red). neutral start switch must be at neutral position.
- Neutral start switch to wiring harness plug terminal 7 (yellow /red).
- Wiring harness plug to starter solenoid (small terminal) (yellow/red). Also, ensure that black (small terminal) wire is grounded.
- Starter solenoid is now closed, completing circuit between large terminal (red/purple) and other large terminal (yellow/red), causing starter motor to crank.

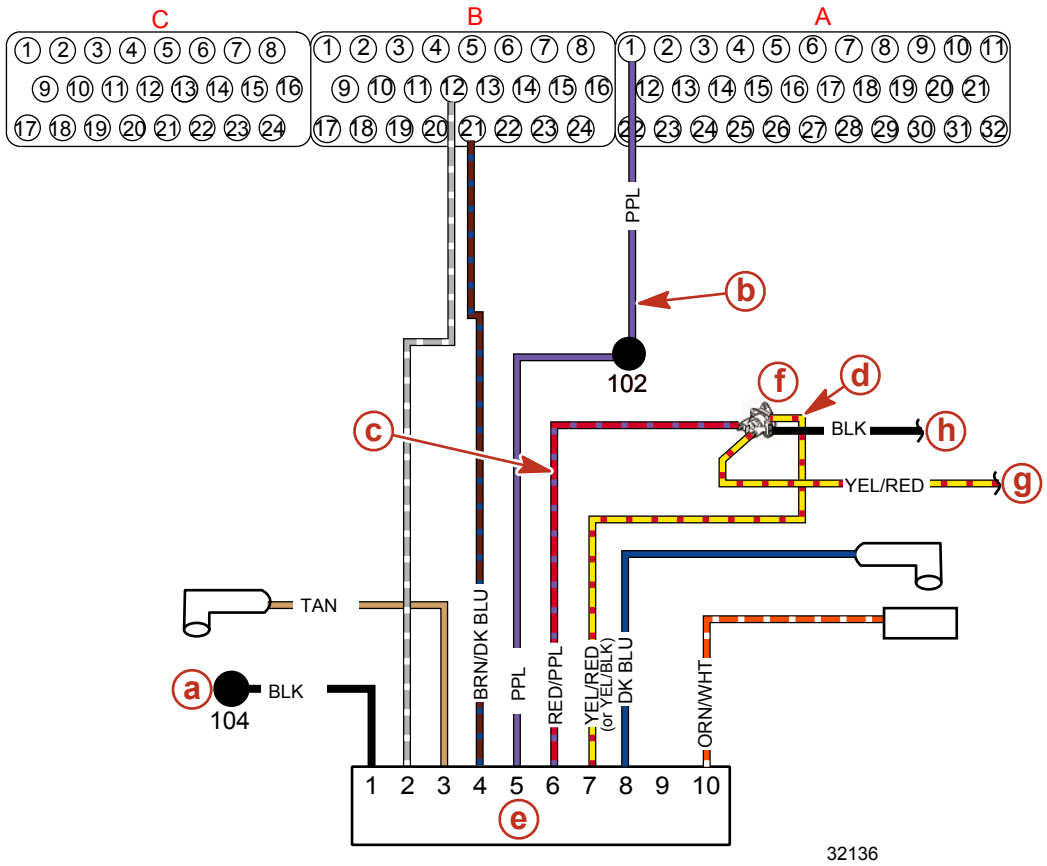
Notes:



Starting and charging harness

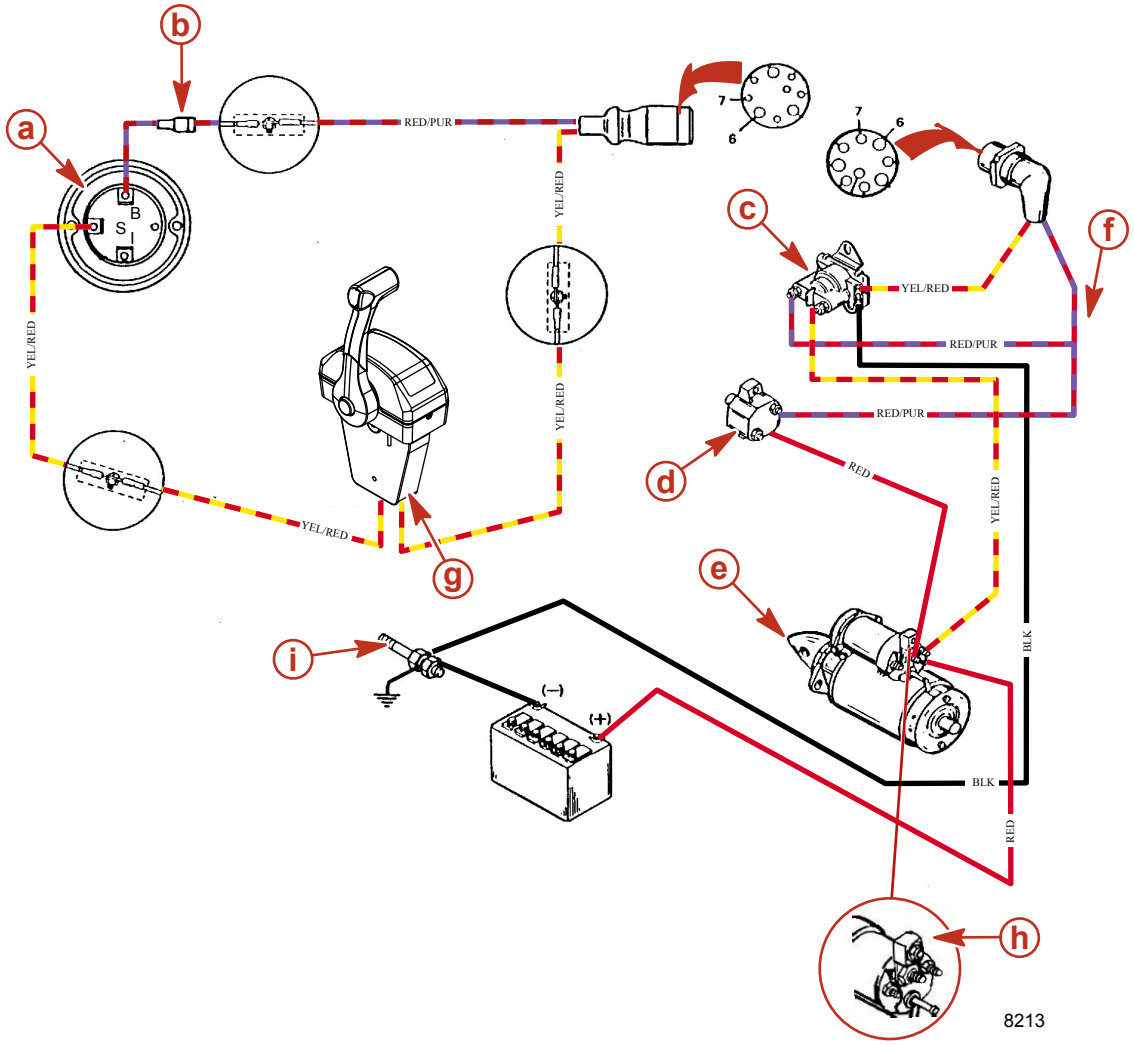
a - 10 Pin connector
b - PCM harness
c - Starter
d - Alternator
e - MerCathode ground (–)
f - Battery power to PCM harness
g - Transmission switch (inboard)
h - Not used
i - Oil sender
j - Trim sender (sterndrive)
k - Tachometer
l - Start solenoid
m - Circuit breaker

Start Circuit with Start Solenoid Relay



a - Ground (–)
b - Wakeup
c - Circuit breaker, 50A
d - Key switch terminal "S" or neutral safety switch
e - 10 Pin connector
f - Start solenoid relay
g - Starter "S" stud
h - Ground (–)

Typical Starting System Components—10-Pin Engine Harness

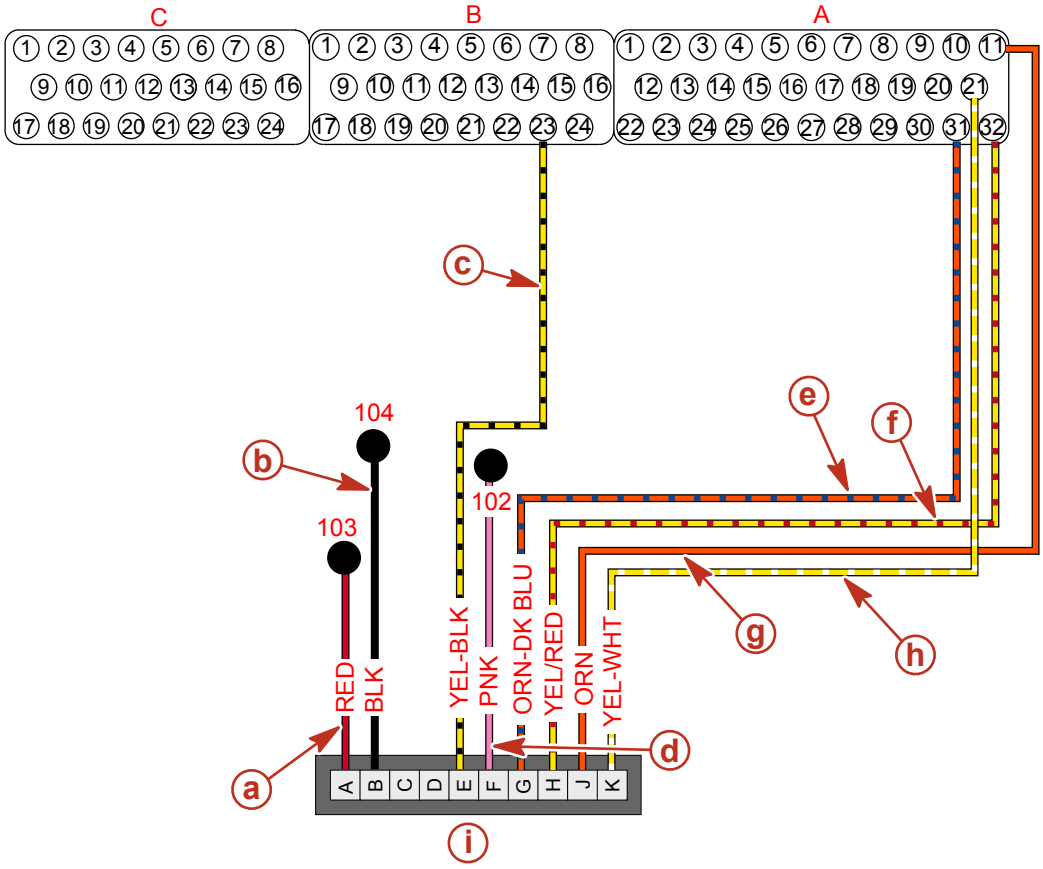


a - Ignition switch
b - 20-amp fuse
c - Starter solenoid or relay
d - 50-amp circuit breaker
e - Starter motor
f - Wire junction
g - Neutral safety switch
h - 90-amp fuse
i - Ground (–)

Single Circuit Diagrams

This section outlines the circuitry of the wiring harness and sensors as individual systems. This allows for a quick reference point when trying to detect a faulty connection. However, the complete system wiring diagram should be referenced if multiple electrical faults are occurring.

Control Area Network (CAN) Circuit

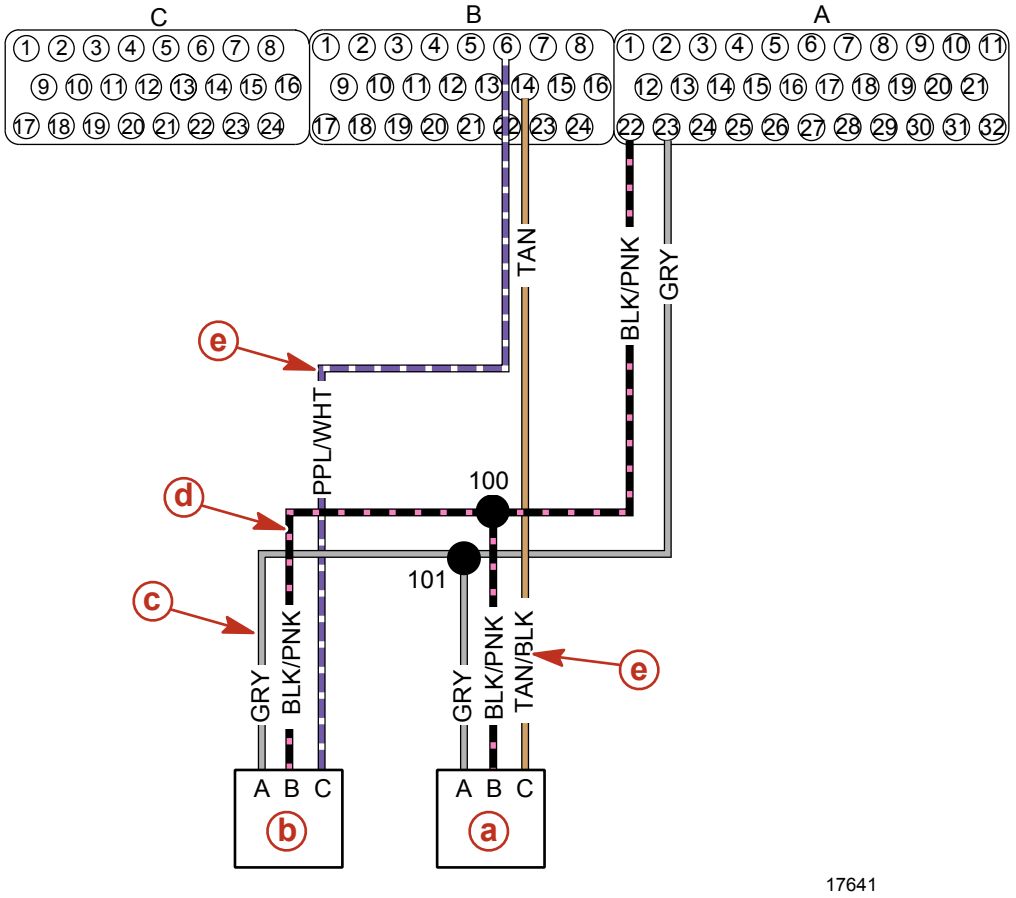


a - Bus 12 volt power
b - Bus ground
c - Emergency stop
d - Wake up line
e - CAN 2 positive (+)
f - CAN 2 negative (–)
g - CAN 1 positive (+)
h - CAN 1 negative (–)
i - CAN line terminator

The CAN circuit powers the SmartCraft gauges (SC1000) on mechanical throttle and shift engines. It is located on the rear of the engine on the upper port side. The gauges operate from bus power and ground. Gauge information (RPM, temperature, trim) is sent through the CAN leads. Emergency stop and wake up is not used on the mechanical models.

A malfunction in the CAN circuit will not set a fault.

Crank Position Sensor (CPS) and Camshaft Position Sensor (CMP) Circuits

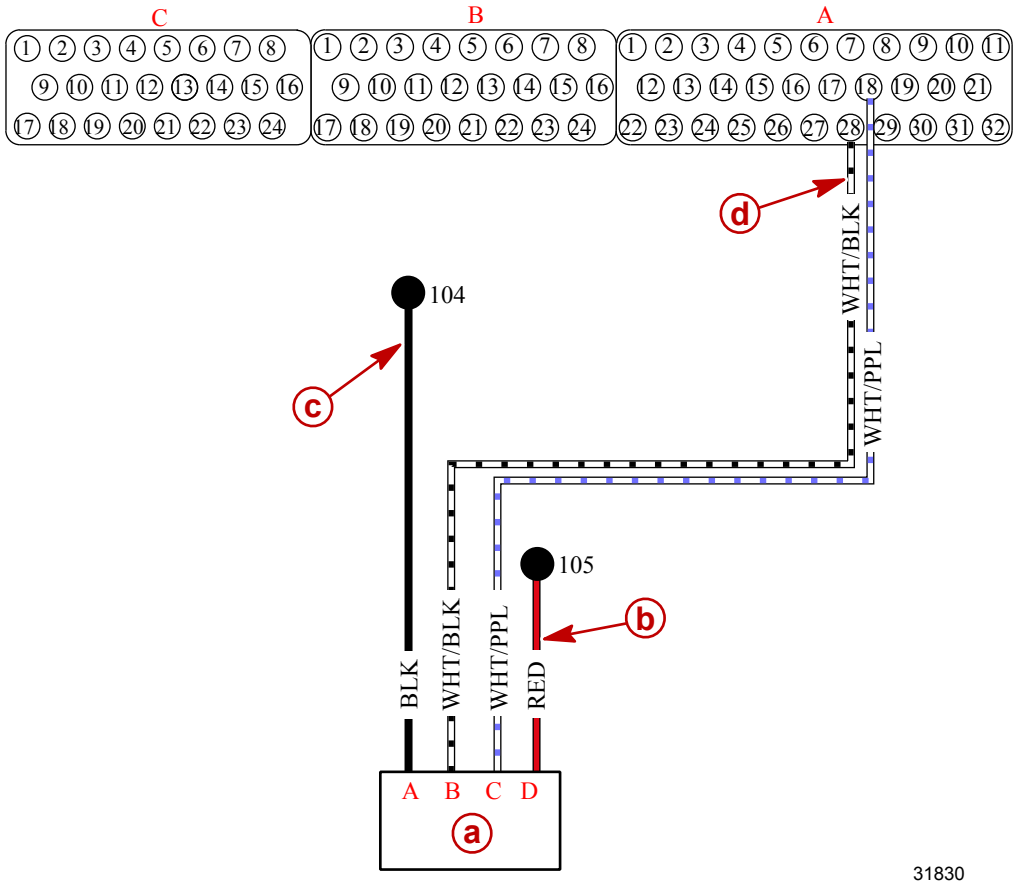


a - Crankshaft position sensor
b - Camshaft position sensor
c - 5 volt power
d - 5 volt ground
e - Signal to the PCM

The crankshaft position sensor (CPS), located at the rear of the engine, and the camshaft position sensor (CMP), located at the front of the engine, supply the PCM with timing and RPM information. If a failure occurs in these sensor circuits, the engine will operate extremely rough or stop operating. Check for continuity between the PCM and the sensor.

With software prior to level 091, a malfunction of the CPS or the CMP will not set a fault. With level 091 software, if the CMP is bad and does not send a signal to the PCM, the engine will backfire and not start. Stop cranking the engine when this occurs and then try again to start the engine. Operate the engine for 20 seconds to set faults. The audio warning alarm will signal 2 beeps per minute. The Smartcraft system monitor will show the check engine light.

Diagnostics Circuit



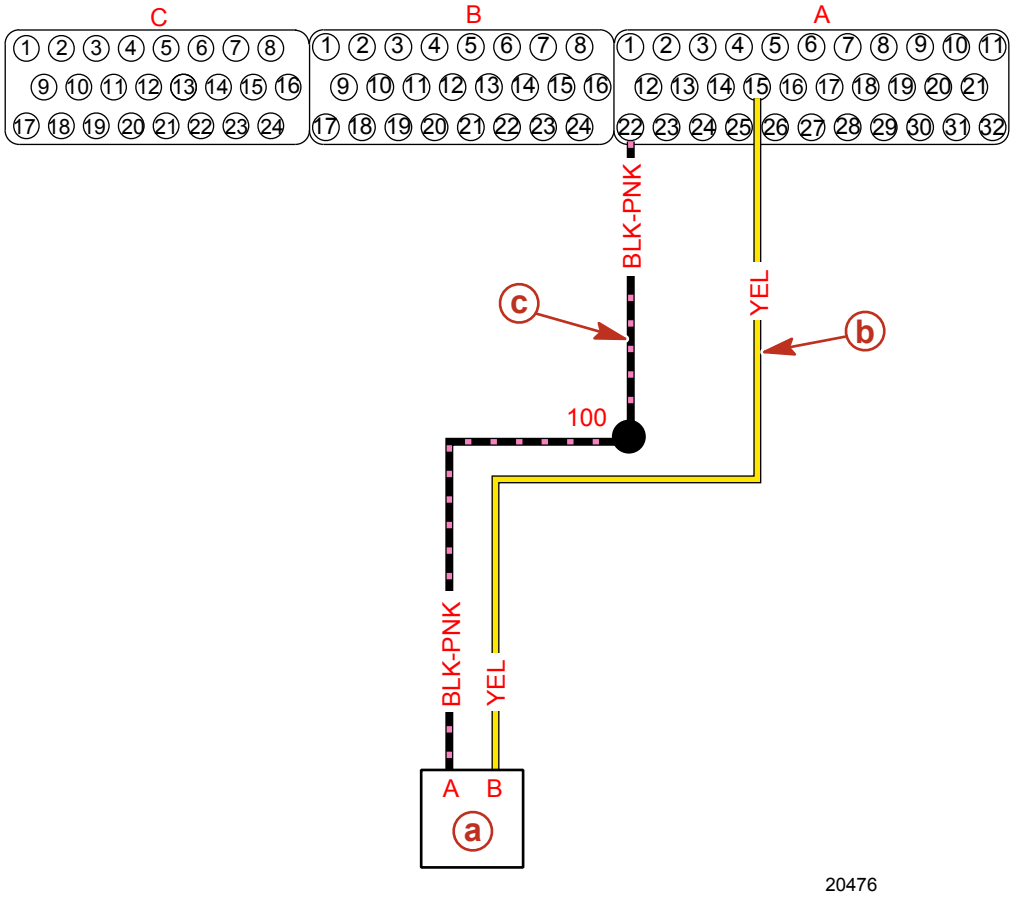
a - Data link connector
b - 12 Volt switched power
c - 12 Volt ground
d - Data leads from PCM

The data link connector (DLC) is a 4 pin circuit for attaching the diagnostic tool to the PCM. It is located on the port side of the engine next to the oil filter. Before attaching a diagnostic tool to the engine, verify that the key is OFF and the pins are clean of corrosion and debris. Pin A is the 12 volt ground connected to the engine harness at splice 104. Pins B and C are data retrieval lines from the PCM. Pin D is the 12 volt supply to the diagnostic tool.

IMPORTANT: Diagnostic tools can only receive data with key ON or engine operating. Diagnostic tools need a minimum of 8 volts. If the diagnostic tool does not respond, verify the connection, verify that the key is ON and check the battery voltage.

A malfunction of the data link connector will not set a fault.

Engine Coolant Temperature Sensor (ECT) Circuit



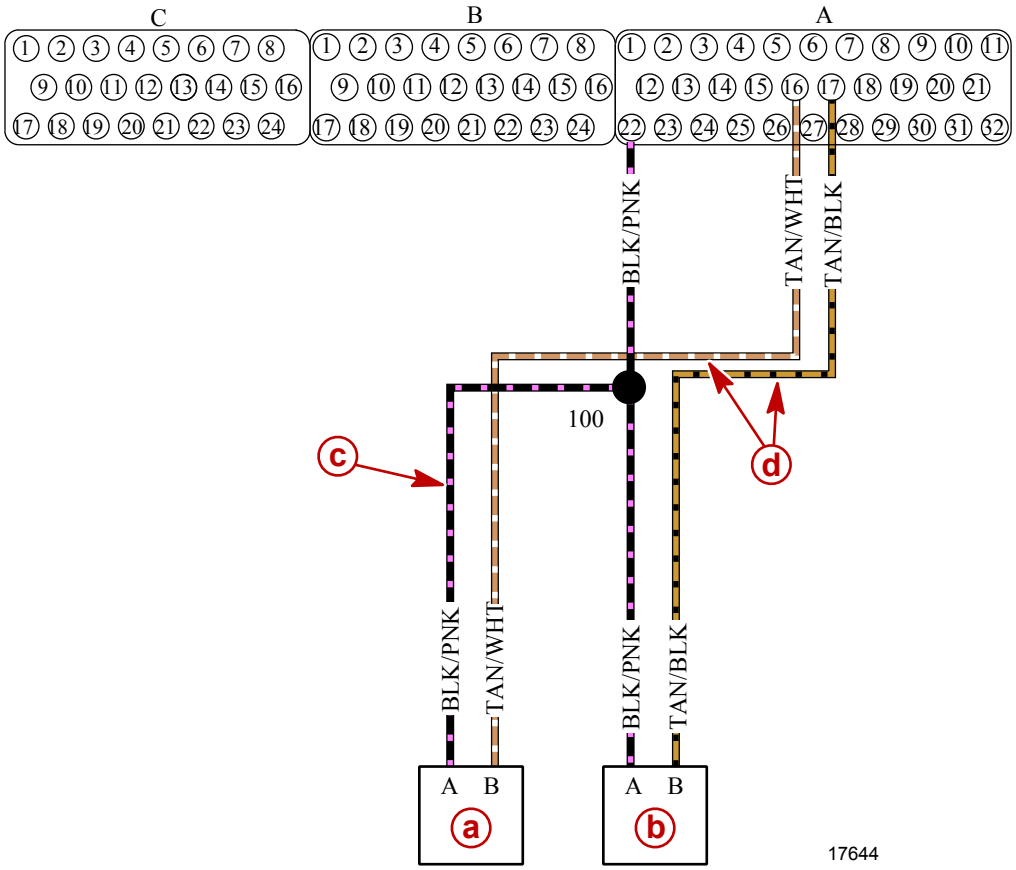
a - Engine coolant temperature sensor (ECT)
b - Signal wire
c - 5 Volt transducer ground

The ECT is a temperature sensor immersed in the engine coolant stream. It is located in the water crossover on the front starboard side of the engine. Low coolant temperature produces high resistance, while high temperature causes low resistance.

A malfunction of the ECT will set a fault of Cool TEMP CKT Hi, Cool TEMP CKT Lo or ECT Coolant Overheat.

Approximate Temperature-To-Resistance Values		
F°	**C°**	**ohms**
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Exhaust Manifold Coolant Temperature Sensor (EMCT) Circuit

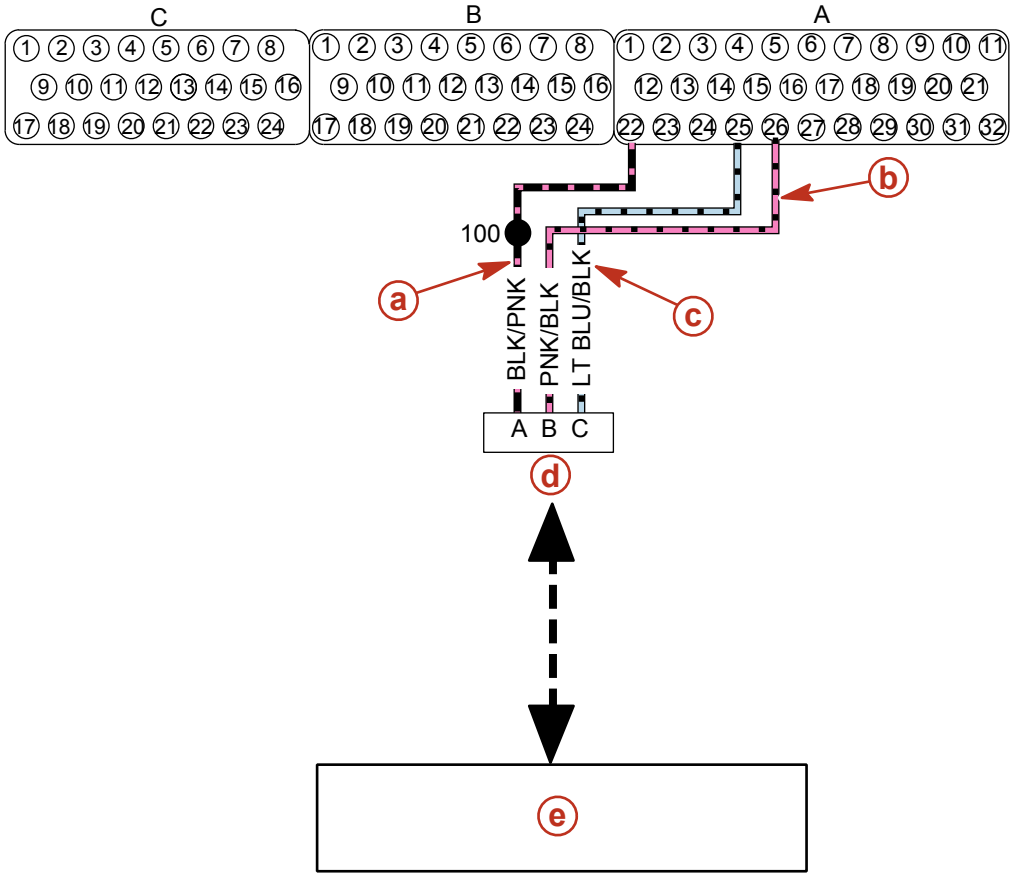


a - Port EMCT sensor
b - Starboard EMCT sensor
c - 5 volt transducer ground (–)
d - Signal to PCM

The exhaust manifold coolant temperature (EMCT) sensors are located on the top of each exhaust manifold. The EMCT sensors are thermistors immersed in the engine exhaust stream. Low temperatures produce high resistance, while high temperatures cause low resistance.

A malfunction of an EMCT sensor will set a fault of Port EMCT CKT Hi, Port EMCT CKT Lo, Port EMCT CKT Overheat, STB EMCT CKT Lo, STB EMCT CKT Hi, or STB EMCT CKT Overheat.

Fuel Level Sensor Circuit—Harness 84-865457A02

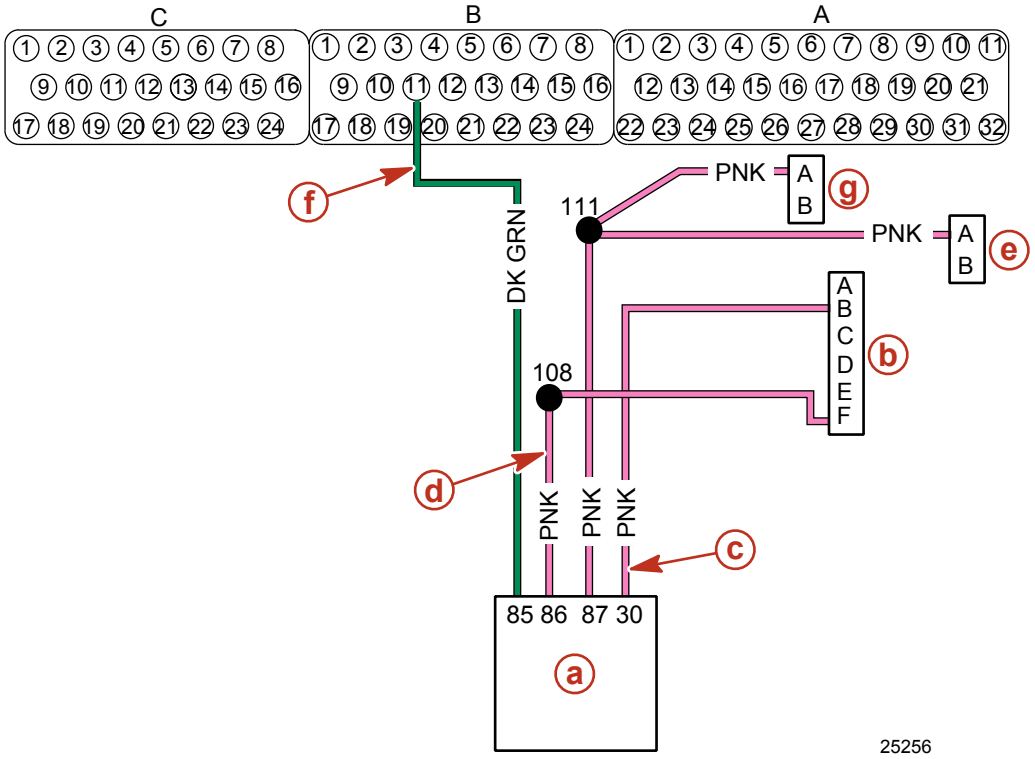


a - 5-volt transducer ground
b - Fuel level 1
c - Fuel level 2
d - Connector—fuel level
e - Extension harness

The fuel level sensor circuit supplies the PCM with the fuel level. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Pump Relay Circuit

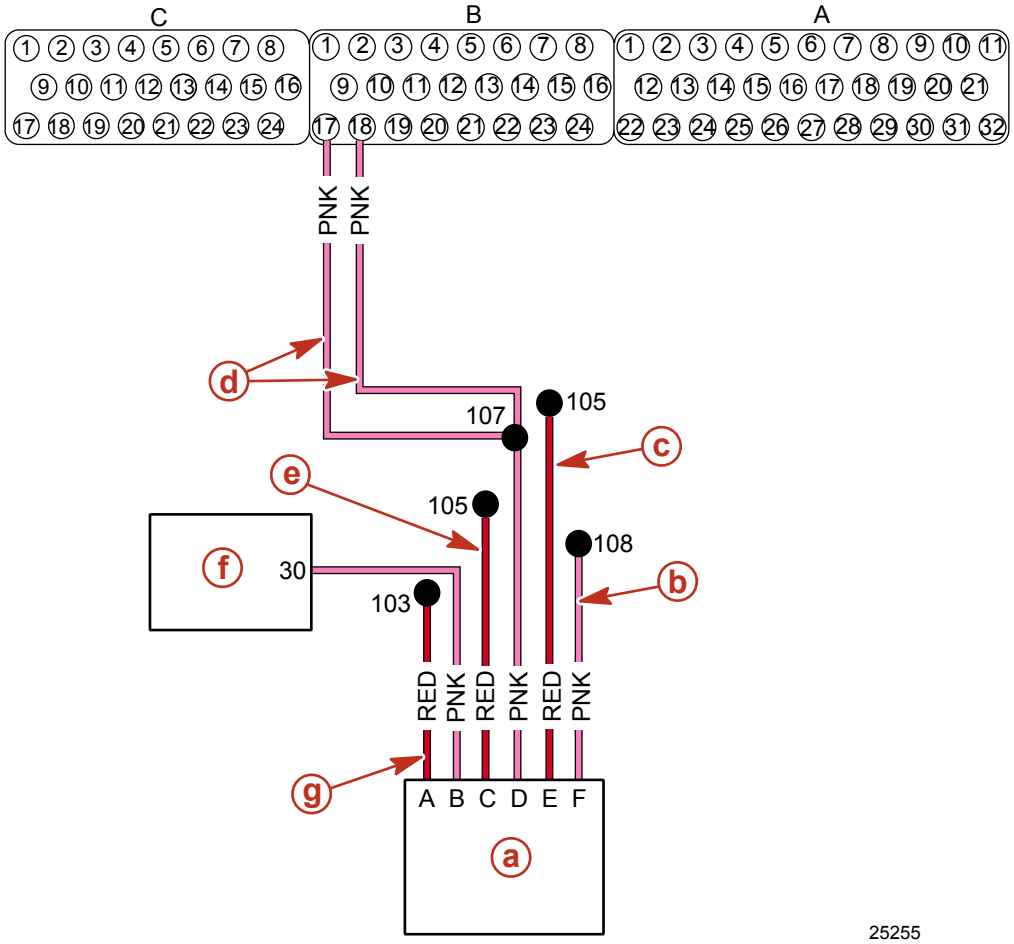


a - Fuel pump relay
b - Fuses
c - 12 Volt power from the fuses
d - 12 Volt power from the fuses
e - Boost pump
f - Signal from PCM
g - Cool fuel

When the key switch is turned to the on position, the fuel pump relay receives 12 V battery power through the fuses at terminal 86 and 30. The relay powers both fuel pumps and is controlled by the PCM. Listen at key on for both fuel pumps to operate.

A malfunction in the fuel pump relay circuit will not set a fault.

Fuse Circuit

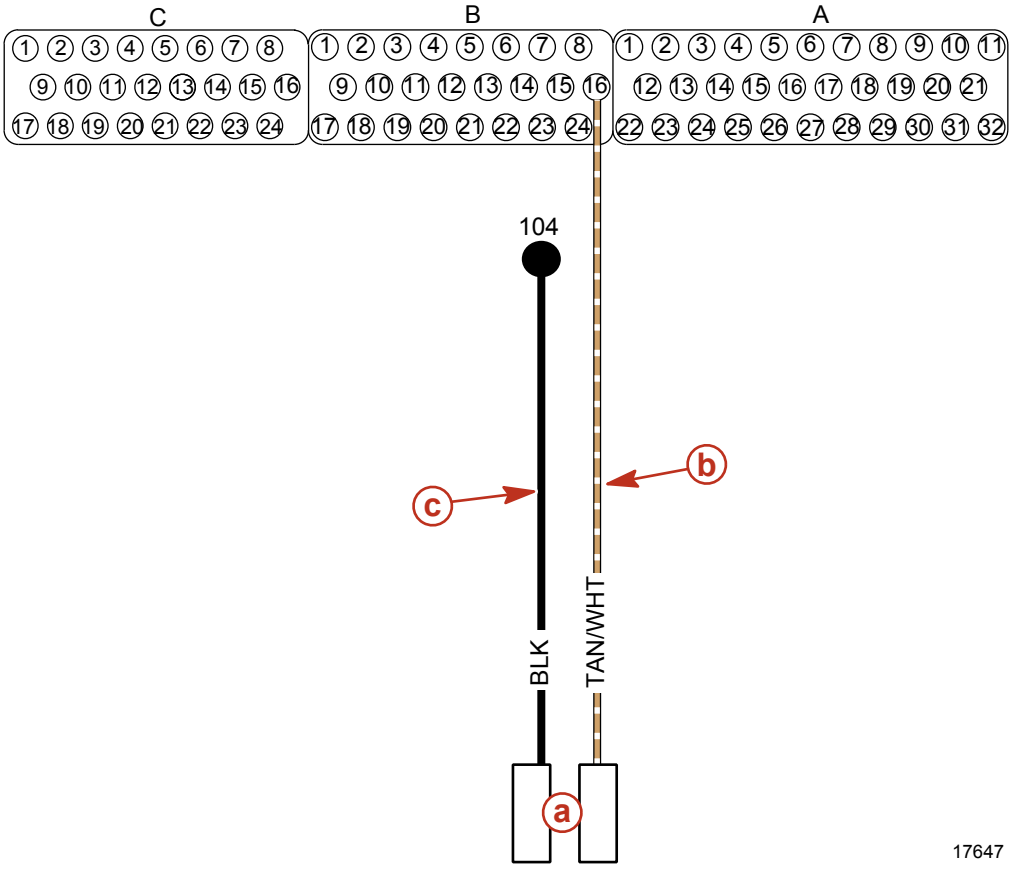


a - Fuses
b - 12 Volt power to fuel injectors
c - Battery power
d - 12 Volt power to PCM
e - Battery power from MPR
f - Fuel pump relay
g - Battery power from MPR

The fuse circuit receives 12 V battery power through Splices 103 and 105. The fuse circuit is located on the upper port side of the engine. The protected power is sent to the PCM, fuel injectors, and fuel pump relay.

A malfunction in the fuse circuit will not set a fault.

Gear Lube Monitor or Transmission Overtemp Circuit



a - Drive gear lube monitor (sterndrive) or transmission temperature sensor (inboard) connectors

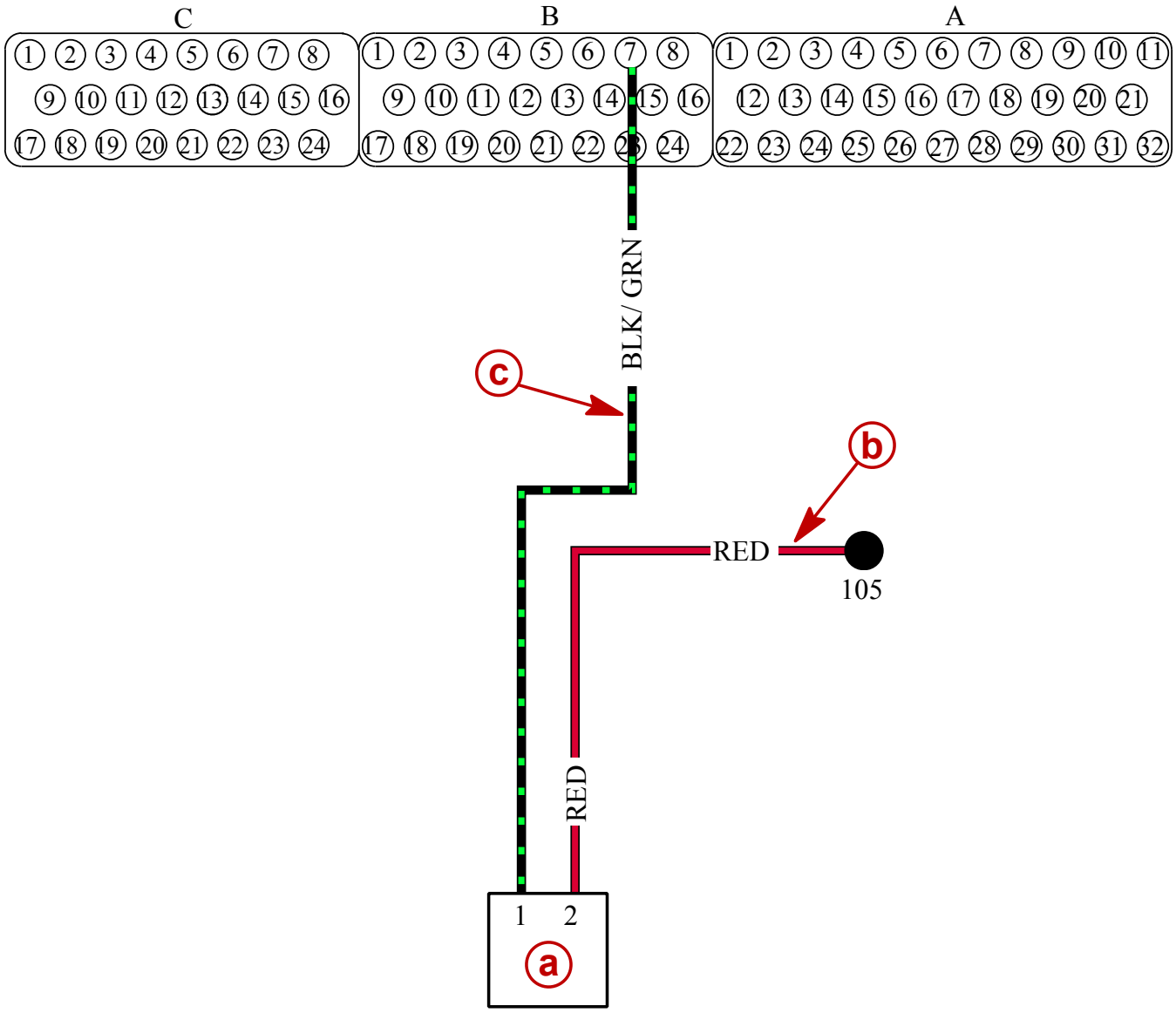
b - Signal wire

c - Ground (–)

The gear lube monitor or transmission overtemp circuit is an open-continuity circuit. The circuit connector is located on the top, port side of the engine. The circuit will show continuity if the level of fluid in the gear lube monitor is low (sterndrive) or it the transmission temperature is excessive (inboard). If a problem is suspected, check continuity. There should be continuity with an empty gear lube monitor and no continuity with a full monitor (sterndrive) or no continuity with transmission temperature low and continuity if transmission temperature is excessive (inboard).

A low level of fluid in the gear lube monitor will set a fault of Low Drive Lube Strategy. Excessive transmission temperature will set a fault.

Idle Air Control Valve (IAC) Circuit—Mechanical

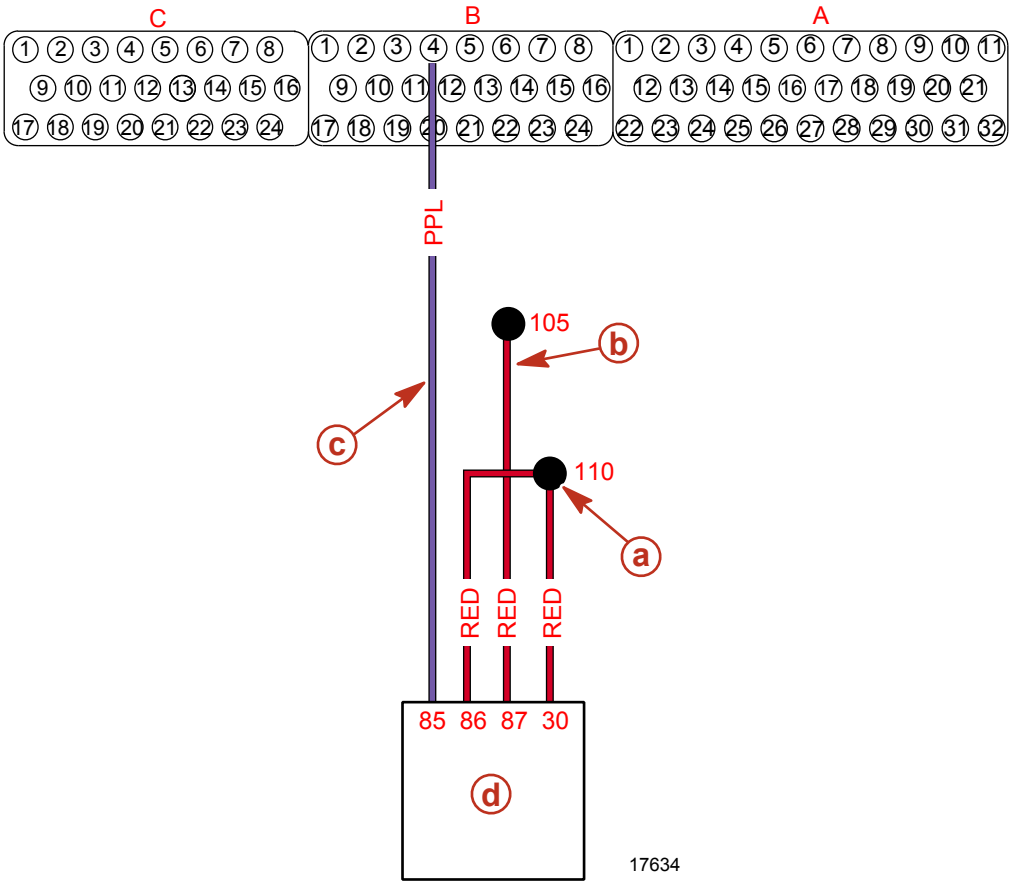


a - IAC sensor connector
b - 12 Volt from the MPR
c - Signal wire

The idle air control valve (IAC) is a transducer powered by 12 volts from the MPR. The IAC is located on top rear of the engine.

A malfunction of the IAC will set a fault of IAC Output.

Main Power Relay (MPR) Circuit—Serial Number OW000000 and Below

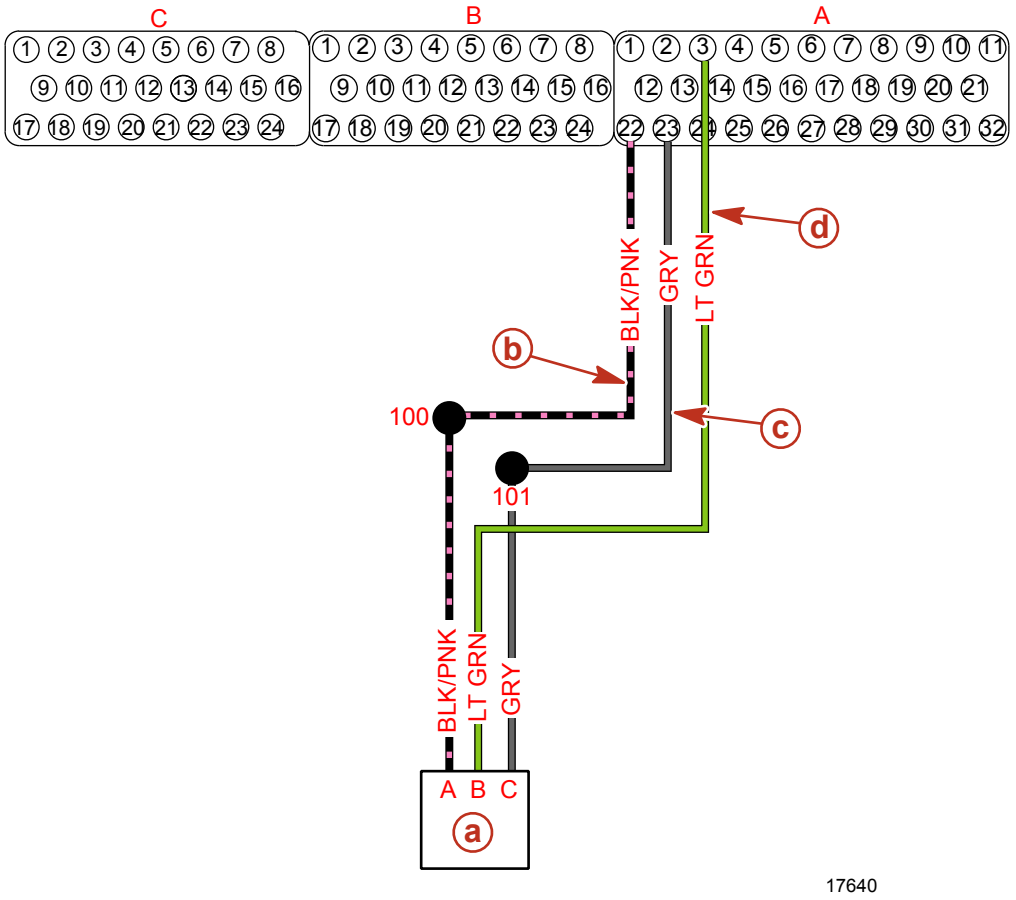


a - 50 A protected battery power
b - Output power to splice 105
c - Signal from PCM
d - MPR

When the key switch is in the on position the main power relay (MPR) is activated and sends 12 volt power to splice 105, which powers the IAC, fuel injectors, and part of the PCM. The MPR is located on the top of the engine near the PCM. Listen for a click on initial key on and check continuity to the MPR if a problem is suspected.

A malfunction of the MPR could result in the fault MPR Output or MPR Backfeed.

Manifold Absolute Pressure Sensor (MAP) Circuit

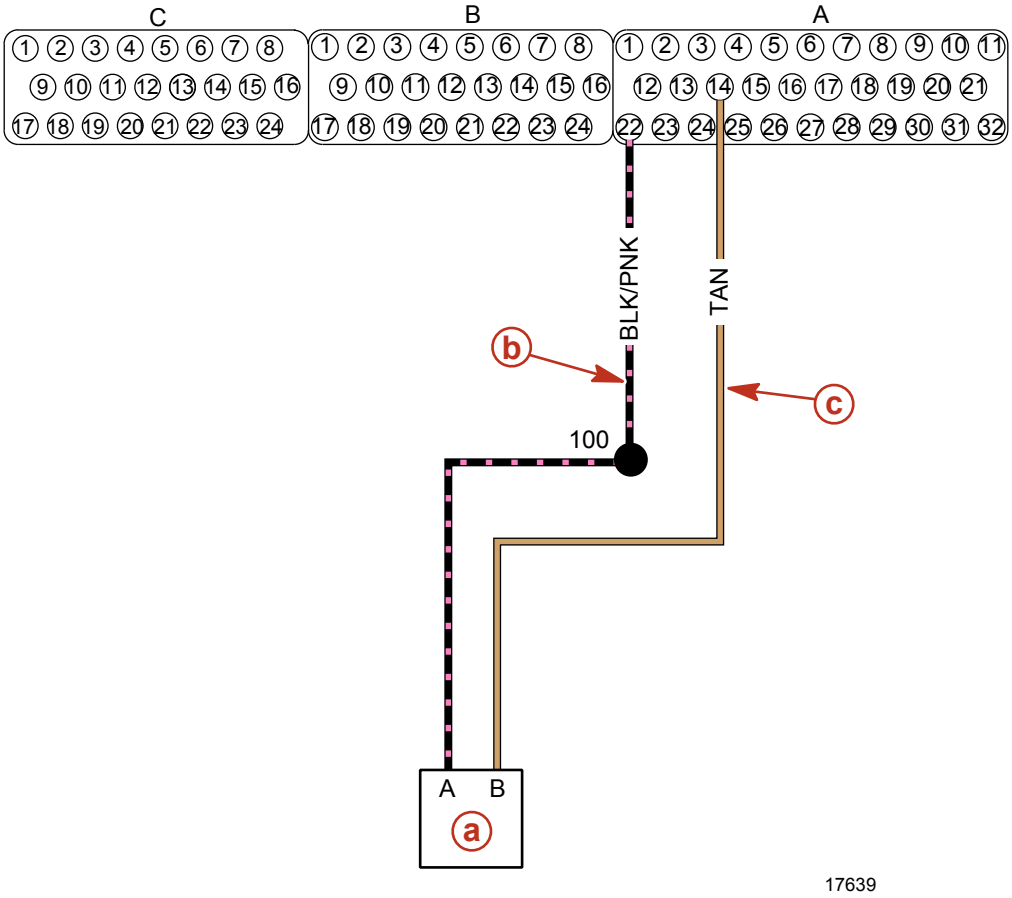


a - Manifold absolute pressure connector
b - 5 volt ground
c - 5 volt power
d - Signal wire

The manifold absolute pressure sensor (MAP) measures the changes in the intake manifold pressure. It is located on the intake manifold on the top of the engine. At key on, the MAP is equal to atmospheric pressure. This information is used by the PCM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading with a known good MAP sensor is a good check of a suspect sensor. The pressure changes as a result of engine load and speed change. The PCM receives this information as a signal voltage that will vary from about 1.0-2.0 volts at idle to about 4.0-5.0 volts at WOT.

A malfunction in the MAP circuit could set the fault MAP Sensor Input HI, MAP Sensor Input LO, or MAP Sensor Idle Rationale.

Manifold Air Temperature Sensor (MAT) Circuit

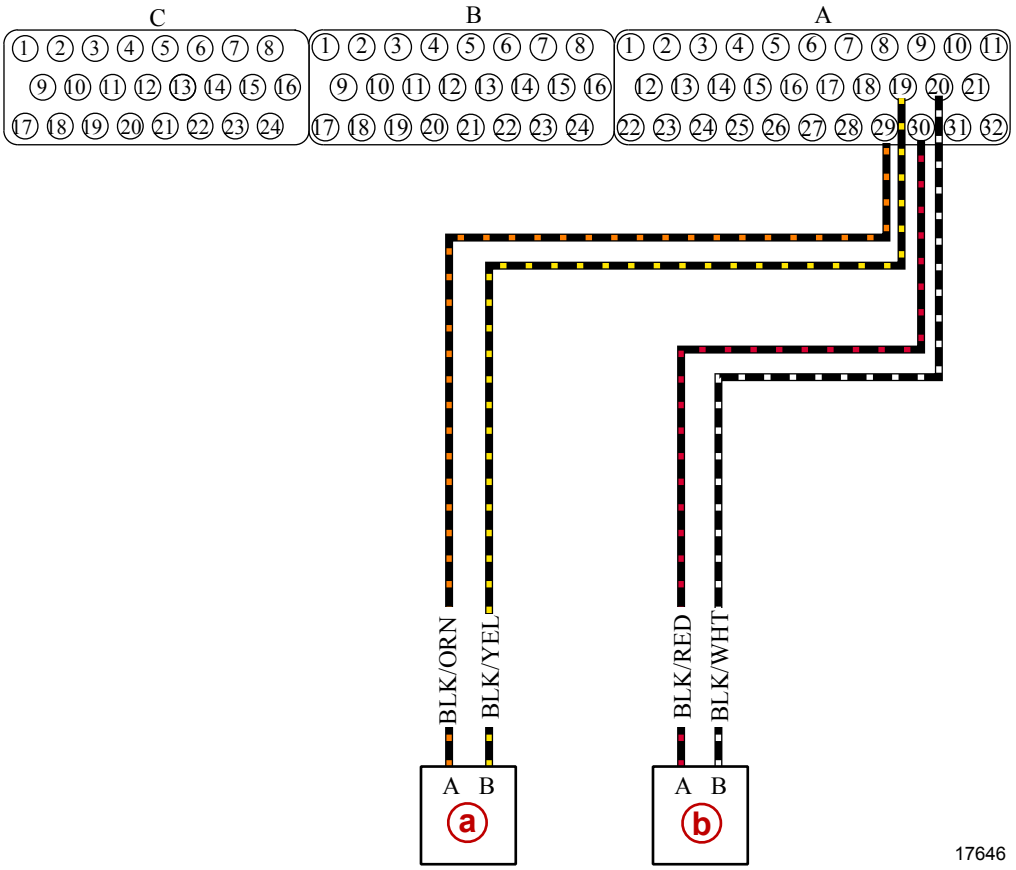


a - Manifold air temperature connector
b - 5 volt ground
c - 5 volt signal wire

The manifold air temperature sensor (MAT) is a thermistor in the manifold air stream. It is located at the rear of the engine in the intake manifold plenum. When intake air is cold, the sensor resistance is high. As the air temperature rises, resistance lowers. At normal engine operating temperature, 71-82° C (160-180° F), the voltage will measure about 1.5 to 2.0 volts.

A malfunction in the MAT will set the fault of AIR TMP CKT Hi or AIR TMP CKT Lo.

Odd and Even Knock Sensor Circuits

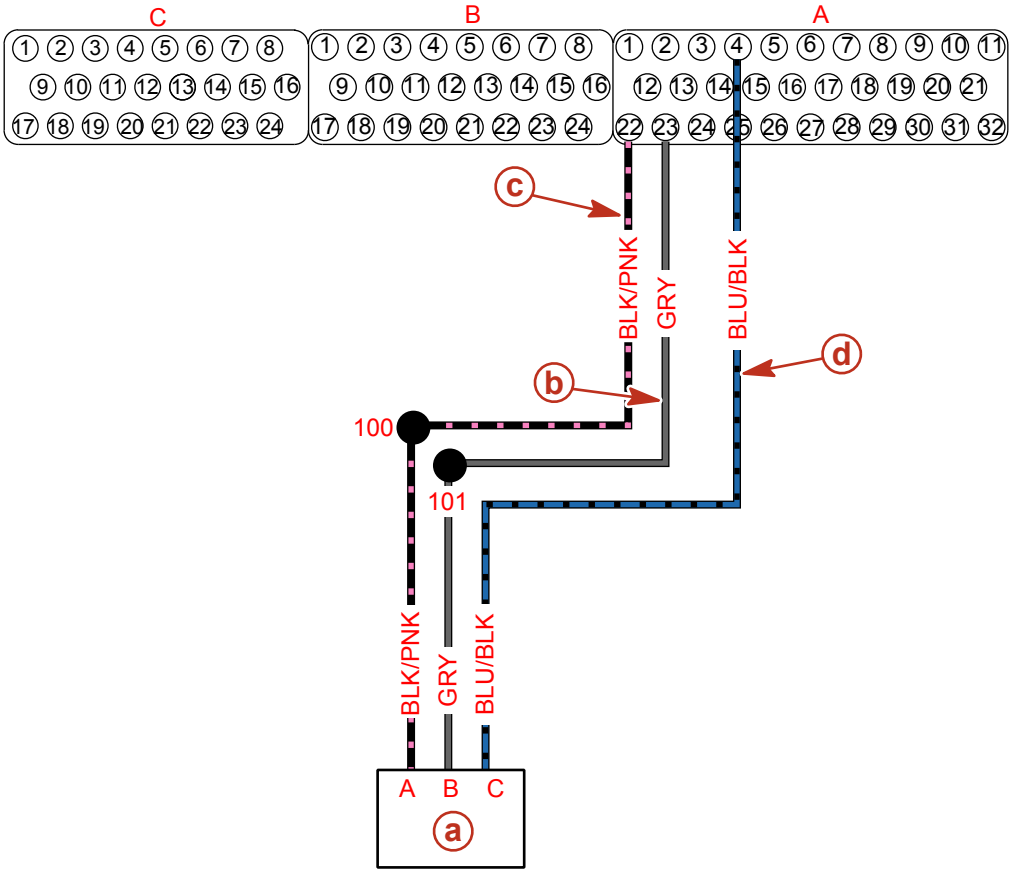


a - Odd knock sensor
b - Even knock sensor

Knock sensors detect engine detonation or spark knock and send a voltage signal to the PCM. The knock sensors are located on the lower half of the engine on the odd (port) and even (starboard) sides. As the sensor detects knock, the voltage output level increases and signals the PCM.

An unacceptable knock sensor reading will set a fault of Knock Sensor HI or Knock Sensor LO.

Oil Pressure Sensor Circuit



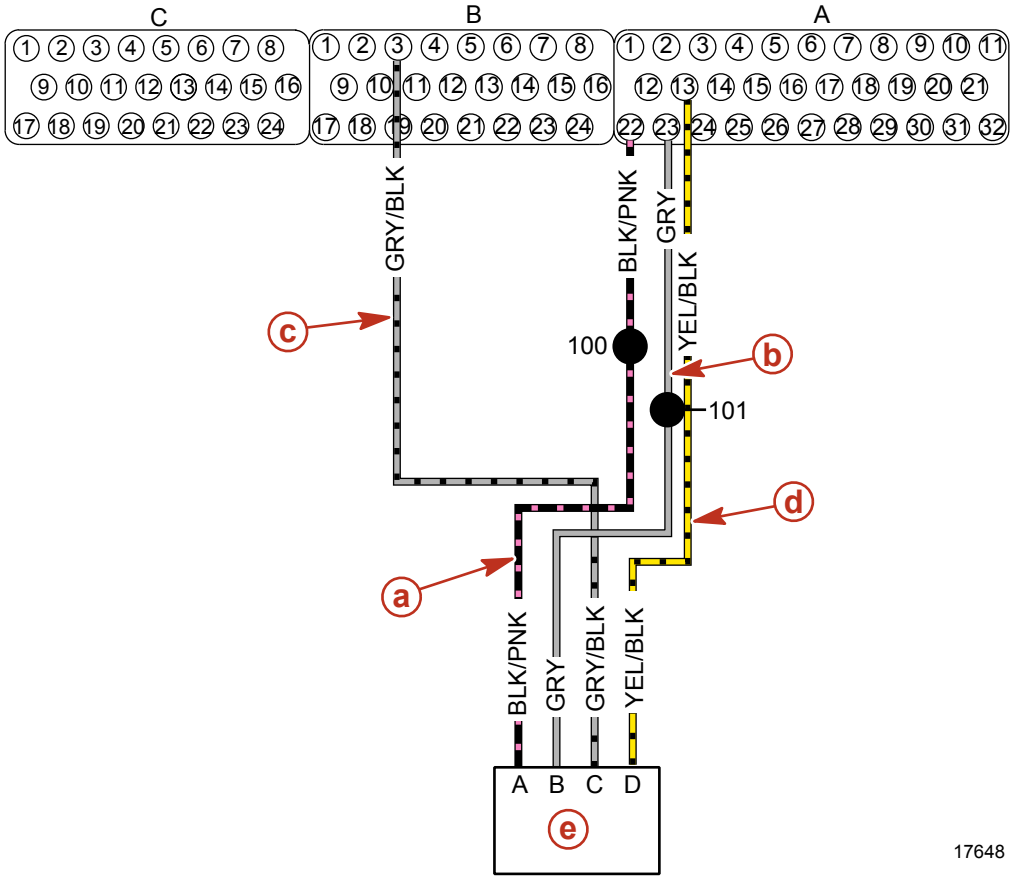
20481

a - Oil pressure sensor
b - 5 volt power
c - 5 volt ground
d - Signal to the PCM

The oil pressure sensor measures oil pressure in the oil galleries. The sensor is located on the rear port side of the engine.

A malfunction of the oil pressure sensor will set the fault Oil PSI CKT Hi, Oil PSI CKT Lo or Oil PSI Lo.

Paddle Wheel and Seawater Temperature Circuit

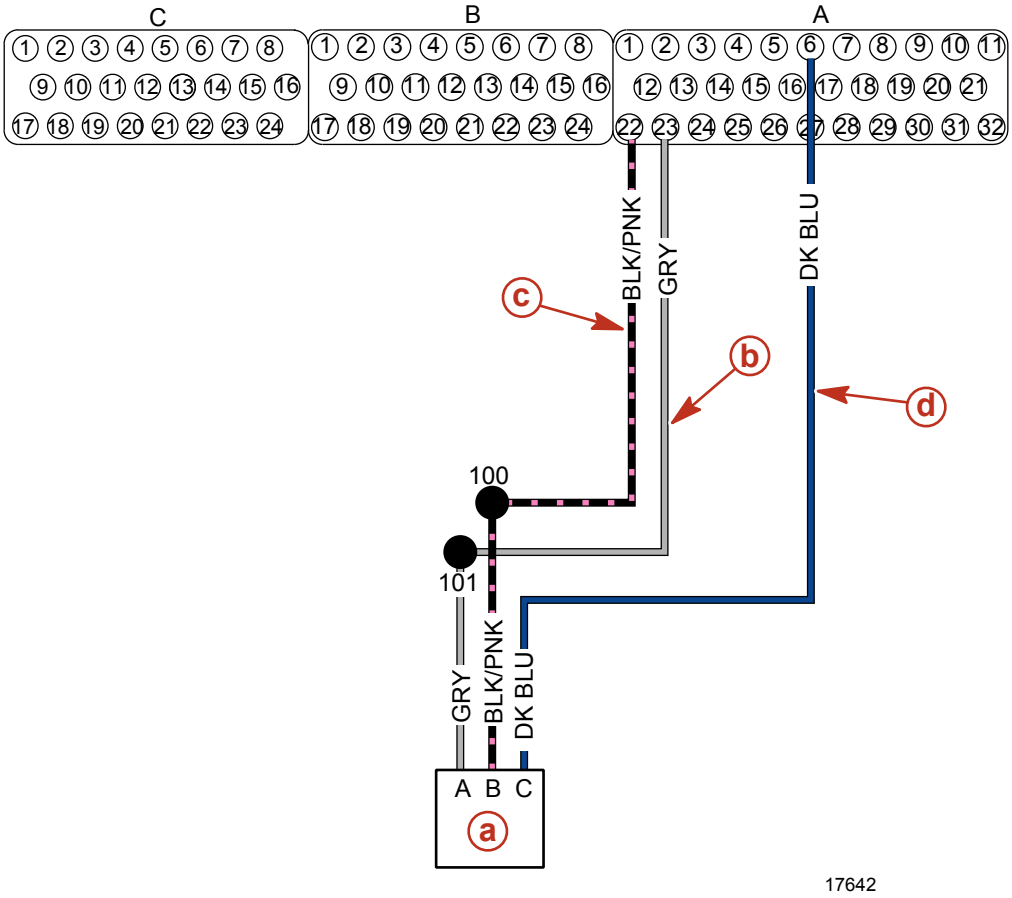


a - 5 Volt transducer ground
b - 5 Volt transducer power
c - Paddle wheel signal
d - Seawater temperature signal

The paddle wheel circuit supplies the PCM with boat speed and seawater temperature readings, it is much more precise than the pitot circuit at lower speeds. It is located on the rear of the engine.

A malfunction in the paddle wheel circuit will not set a fault.

Throttle Position Sensor (TPS) Circuit—Harness 84-863084A1 and 84-862536A1

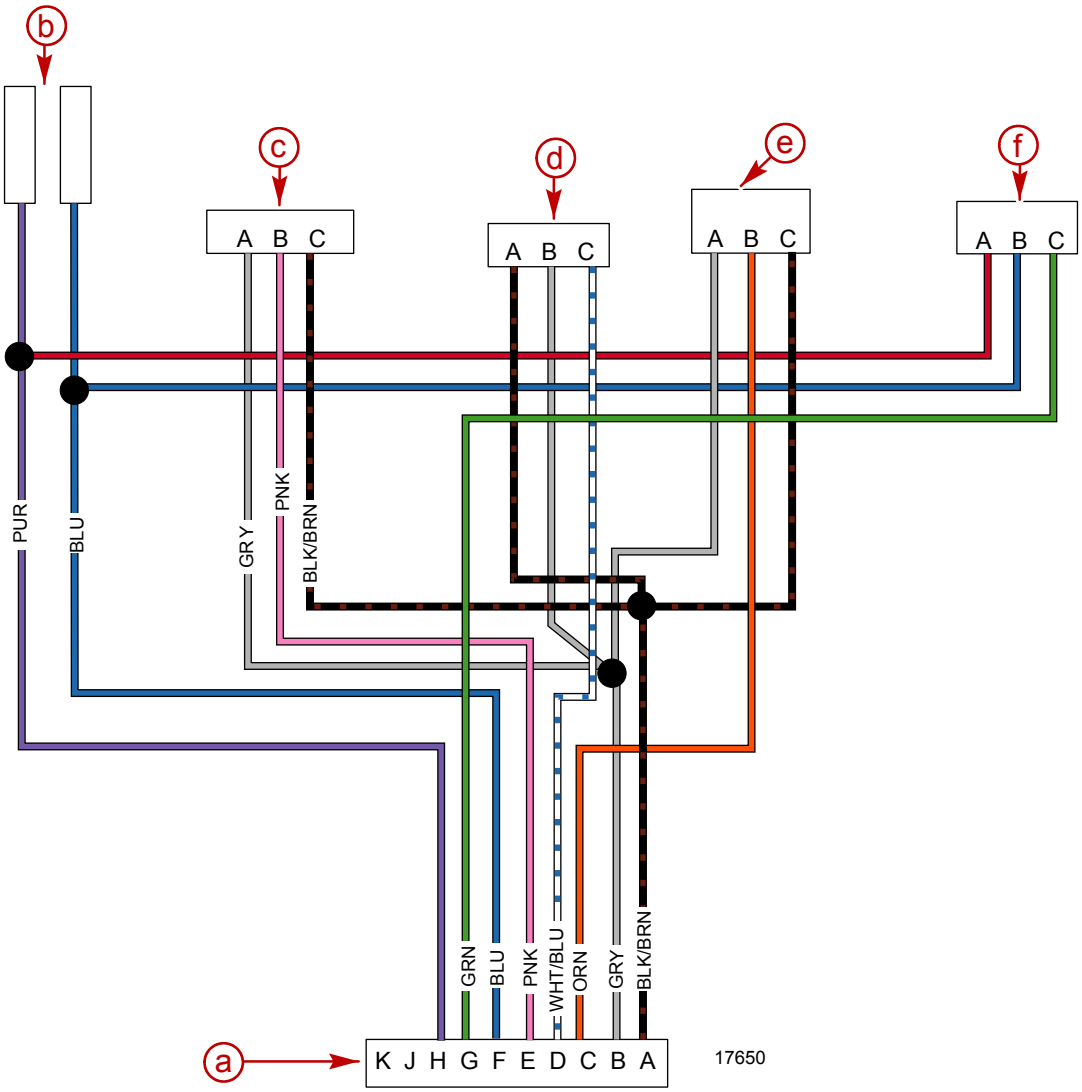


a - Throttle position sensor (TPS)
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The throttle position sensor (TPS) sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at WOT. If the TPS malfunctions, the ECM will reset to a default value.

A malfunction in the TPS circuit will set the fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo or TPS No Adapt.

Transom Circuit (Transom Harness)—Sterndrive Mechanical



a - Transom harness to engine harness connector

b - Trim limit connectors on mechanical throttle and shift

c - Steering sensor connector

d - Speedometer sensor

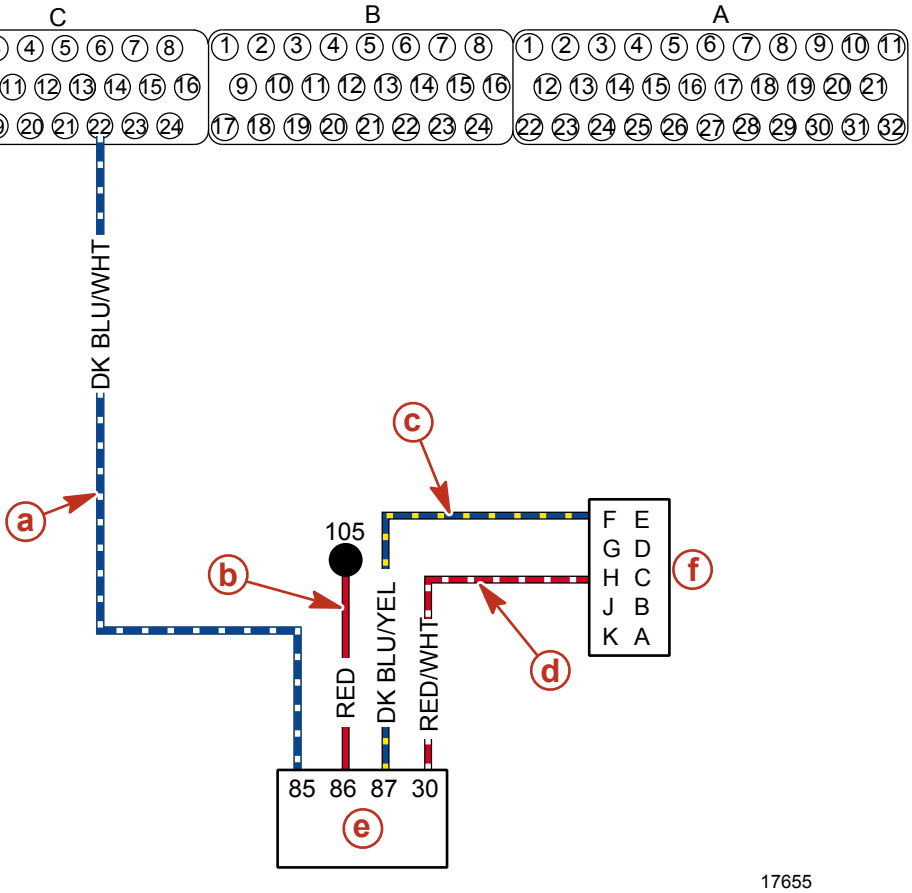
e - Trim sensor

f - Trim limit connector for electronic throttle and shift

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the engine harness and the inner transom. Do not connect both of the trim limit connectors, "b" and "f" simultaneously as this will cause a failure in the trim limit circuit.

A malfunction in the transom harness will set the fault of Trim CKT HI, Trim CKT LO, Steering Angle Input HI, or Steering Angle Input LO.

Trim Up Relay Circuit

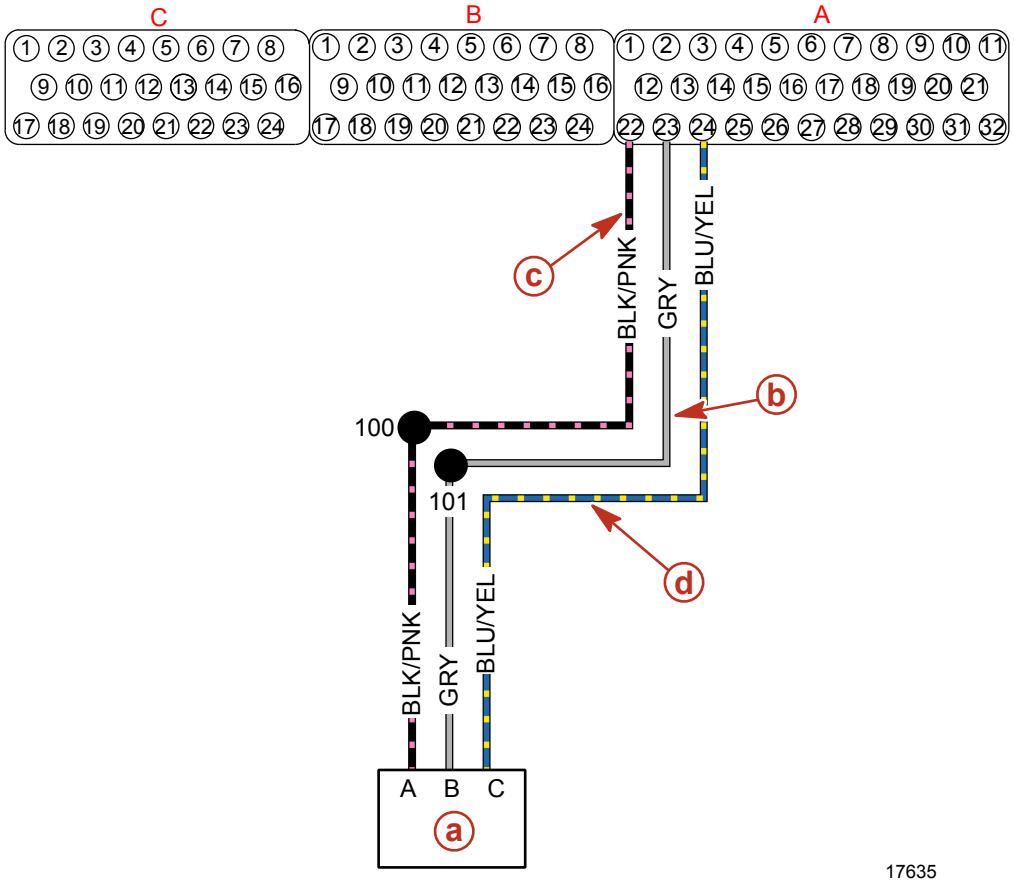


a - Relay control from PCM
b - 12 volt power to trim up relay
c - Trim up signal to trim pump
d - 12 volt power from trim pump
e - Trim up relay
f - Transom harness

The trim up relay circuit receives power through Splice 105 and signals through the smart transom to trim the sterndrive unit. It is located on the upper port side of the engine.

A malfunction in the trim up relay circuit will set the fault Trim CKT Hi or Trim CKT Lo.

Seawater Pump Circuit

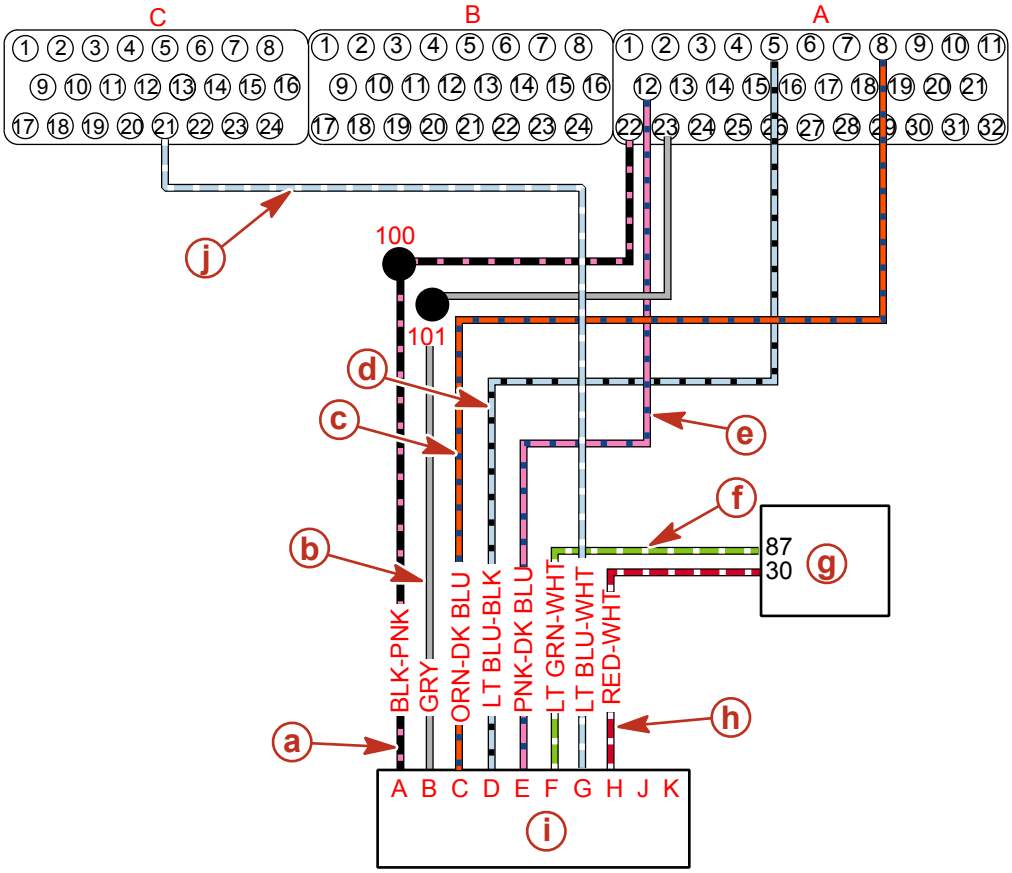


a - Seawater pump sensor connector
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The seawater pump sensor measures water inlet pressure or water block pressure. It is located at the seawater pump inlet hose. Normal diagnostic tool ranges are 7-34 kPa (1-5 psi) at idle and 48-117 kPa (7-17 psi) at WOT.

A malfunction of the seawater pump sensor will set the fault of Seapump CKT Hi, Seapump CKT Lo or Seapump PSI Lo.

Smart Transom Circuit (Engine Harness)



a - Transducer ground
b - 5 Volt transducer power
c - Trim position signal
d - Pitot signal
e - Steering signal
f - Trim up signal
g - Trim up relay
h - 12 Volt power from trim up relay
i - Transom harness connector
j - Trim down relay control

The smart transom harness connection is located at the rear of the engine on the upper port side. It controls communication between the transom sensors and the PCM. Pin B supplies 5 volt power to the trim position sensor, pitot and steering.

A malfunction in the smart transom circuit will set a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo.

Notes:

Diagrams

Section 3B - Diagrams—Integrated

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Engine Harness

Wiring Color Legend

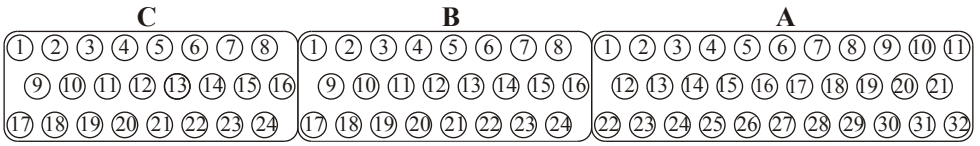
Wire Label	Wire Color
BLU	Blue
DK BLU	Dark Blue
LT BLU	Light Blue
BLK	Black
GRA or GRY	Gray
GRN	Green
DK GRN	Dark Green
ORN	Orange
PPL or PUR	Purple
RED	Red
TAN	Tan
WHT	White
YEL	Yellow

Wire Splice Description—Integrated

Splice Number	Description
100	5 volt transducer ground
101	5 volt transducer power for sensors
102	Wake line, fused 20 ampere, 12 volt power (key on only)
104	Battery ground (–), 12 volt
105	Main power relay (key on only), 12 volt
106	EST return
107	Power to PCM, 12 volt fused
108	Power to the trim relay, IAC, and injectors, 12 volt fused
110	12 volt power, 50 ampere protected
114	Tachometer lead
115	Drive and transmission lubricant

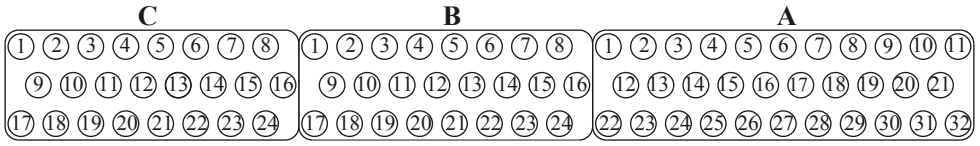
PCM 555 Pin-out—Integrated, Non-DTS

Use this table as a quick reference guide to the pins of the PCM to verify broken pins, what the pins control, and to aid in checking circuit continuity.



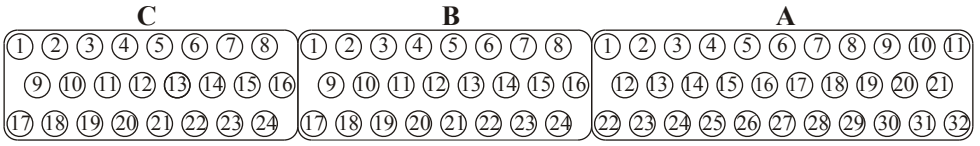
Connector A—Integrated, Non-DTS

Mercury Part Number		84-865457A02	84-865457A05
Pin		Integrated—Non-DTS	Integrated—Non-DTS
A1	Key-on Power (Wakeup)	PPL	PPL
A2	Shift Position (From ESC)	Empty	Empty
A3	MAP Signal	LT GRN	LT GRN
A4	Oil Pressure Signal	DK BLU/BLK	BLU/BLK
A5	Pitot Signal	WHT/LT BLU	WHT/LT BLU
A6	Throttle Position Sensor 1 Signal	DK BLU/ORN	DK BLU/ORN
A7	Throttle Position Sensor 2 Signal	Empty	WHT
A8	Digital Trim Signal	ORN/WHT	ORN/PNK
A9	Starboard Tab Position Signal	DK BLU/RED	Empty
A10	Port Tab Position Signal	GRY/RED	Empty
A11	CAN Line 1 Pos (+)	WHT	WHT
A12	Steering Position (Smart Transom)	PNK/DK BLU	PNK/DK BLU
A13	Seawater Temperature Signal	WHT/YEL	WHT/YEL
A14	MAT Signal	TAN/YEL	TAN/YEL
A15	ECT Signal	YEL	YEL
A16	Port EMCT Signal	BRN/WHT	BRN/WHT
A17	Starboard EMCT Signal	BRN/BLK	BRN/BLK
A18	Scan (–)	WHT/PPL	WHT/PPL
A19	Odd (Port) Knock Sensor 1 (–)	ORN/BLK	ORN/BLK
A20	Even (Starboard) Knock Sensor 2 (–)	YEL/DK BLU	YEL/BLU
A21	CAN 1 Line Neg (–)	LT BLU	LT BLU
A22	Sender Ground	BLK/PNK	BLK/PNK
A23	Sender Power	GRY	GRY
A24	Seapump Signal	DK BLU/WHT	DK BLU/WHT
A25	Fuel Level 2 Signal	LT BLU/BLK	LT BLU/BLK
A26	Fuel Level 1 Signal	PNK/BLK	PNK/BLK
A27	Empty	Empty	Empty
A28	Scan (+)	WHT/BLK	WHT/BLK
A29	Odd (Port) Knock Sensor 1 (+)	BLK/ORN	BLK/ORN
A30	Even (Starboard) Knock Sensor 2 (+)	DK BLU/YEL	BLU/YEL
A31	CAN 2 Pos (+)	DK GRN/ORN	Empty
A32	CAN 2 Neg (–)	DL GRN/RED	Empty



Connector B—Integrated, Non-DTS

Mercury Part Number		84-865457A02	84-865457A05
Pin		Integrated—Non DTS	Integrated—Non DTS
B1	EST Return	BRN	BRN/YEL
B2	EST Coil 1 Trigger	WHT/BLK	WHT/BLK
B3	Paddle Wheel Signal	YEL/GRY	YEL/GRY
B4	Main Power Relay Control	PPL/DK-GRN	PPL/DK-GRN
B5	Empty	Empty	Empty
B6	CAM Sensor Signal	PPL/WHT	PPL/WHT
B7	IAC Valve Control	BLK/DK-GRN	GRN/RED
B8	Assist Solenoid, Start	Empty	Empty
B9	EST Coil 5 Trigger	WHT/LT-BLU	WHT/LT-BLU
B10	EST Coil 3 Trigger	WHT/PPL	WHT/PPL
B11	Fuel Pump Relay Control	DK-GRN	GRN
B12	Tachometer	GRY/WHT	GRY/WHT
B13	Empty	Empty	Empty
B14	Crankshaft Position Sensor Signal	TAN/BLK	TAN/BLK
B15	Gear Position Switch Signal	YEL/DK-GRN	YEL/GRN
B16	Drive Lube Monitor Or Trans Oil Temp Switch	DK-BLU/BRN	DK-BLU/BRN
B17	MPR Output (to PCM)	PNK/LT-GRN	PNK/LT-GRN
B18	MPR Output (to PCM)	PNK/LT-GRN	PNK/LT-GRN
B19	Empty	Empty	Empty
B20	Fuel Injector 4	LT-GRN/BLK	LT-GRN/BLK
B21	Warning Horn	BRN/DK-BLU	BRN/DK-BLU
B22	Fuel Injector 3	LT-GRN/LT-BLU	LT-GRN/LT-BLU
B23	E-Stop	DK-GRN/YEL	GRN/YEL
B24	Power 2 (Smartcraft Sensors)	Empty	GRY/BLK

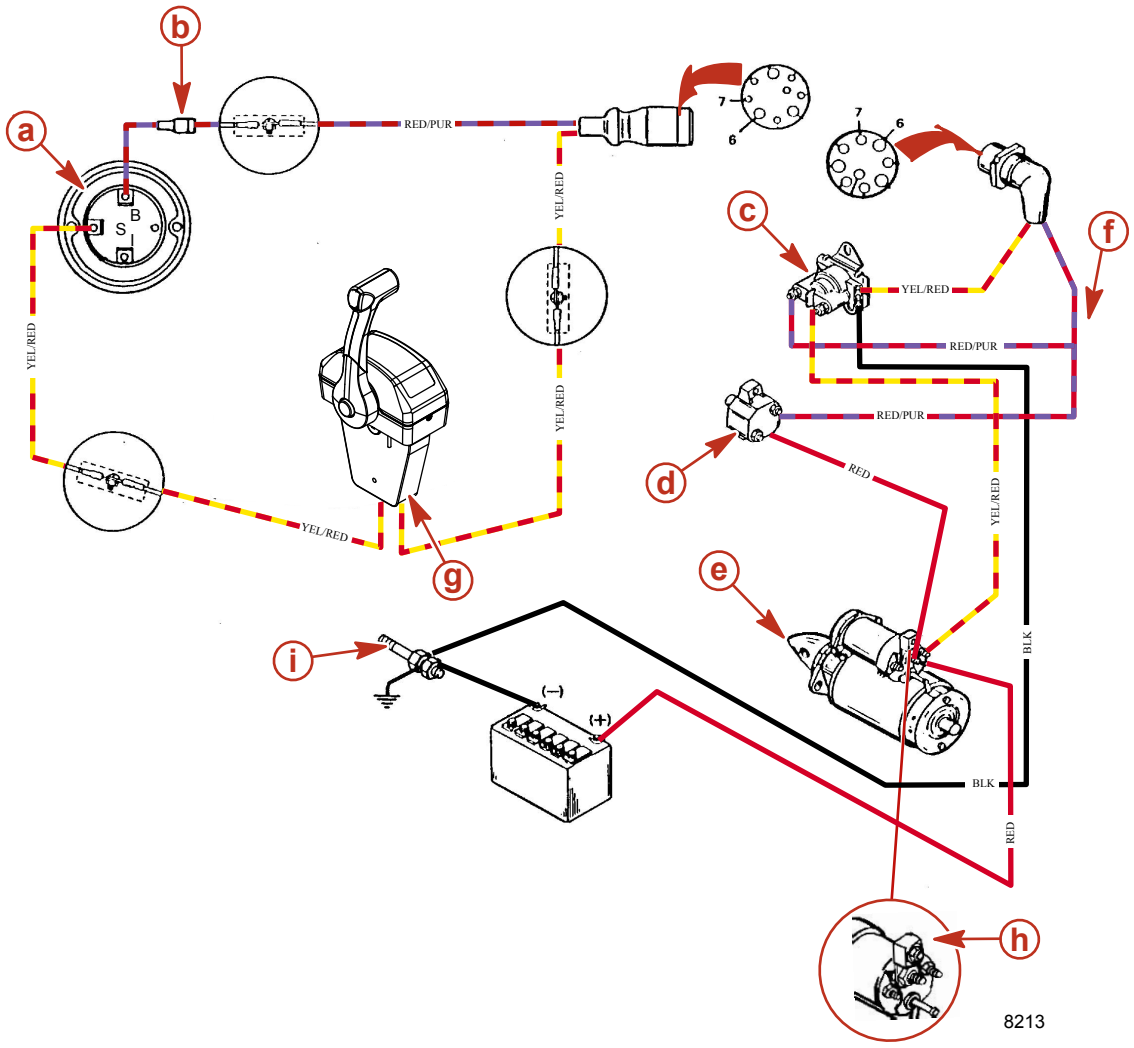


Connector C—Integrated, Non-DTS

Mercury Part Number		84-865457A02	84-865457A05
Pin		Integrated—Non DTS	Integrated—Non DTS
C1	Port Tab Up Solenoid	BLK/BLU	Empty
C2	ETC Pin 3 (Driver)	Empty	Empty
C3	Fuel Injector 8	LT-GRN/DK-BLU	LT-GRN/DK-BLU
C4	ETC Pin 5 (Driver)	Empty	Empty
C5	Fuel Injector 7	LT-GRN/BLK	ORN/GRY
C6	Fuel Injector 1	LT-GRN/ORN	LT-GRN/ORN
C7	EST Coil 4 Trigger	WHT/RED	WHT/RED
C8	EST Coil 2 Trigger	WHT/DK-GRN	WHT/GRN
C9	Starboard Tab Up Solenoid	BLK/LT-GRN	Empty
C10	Starboard Tab Down Solenoid	GRY/DK-BLU	Empty
C11	Fuel Injector 2	LT-GRN/PPL	LT-GRN/PPL
C12	EST Coil 6 Trigger	WHT/LT-GRN	WHT/BRN
C13	EST Coil 7 Trigger	WHT/BLU	WHT/DK-BLU
C14	EST Coil 8 Trigger	WHT/PPL	WHT/PPL
C15	Ground, Power 1	BLK	BLK
C16	Ground, Power 2	BLK	BLK
C17	ESC Pin D (Driver)	Empty	Empty
C18	ESC Pin E (Driver)	Empty	Empty
C19	Port Tab Down Solenoid	GRY/DK-GRN	Empty
C20	Empty	Empty	Empty
C21	Fuel Injector 6	LT-GRN/RED	LT-GRN/RED
C22	Trim Up Relay	DK-BLU/RED	BLU/RED
C23	Fuel Injector 5	LT-GRN/WHT	LT-GRN/WHT
C24	Ground	BLK	BLK

Wiring Diagrams

Typical Starting System Components



a - Ignition switch
b - 20-amp fuse
c - Starter relay
d - Circuit breaker
e - Starter motor
f - Wire junction
g - Neutral safety switch
h - 90-amp fuse
i - Engine ground (–)

Positive Current Flow

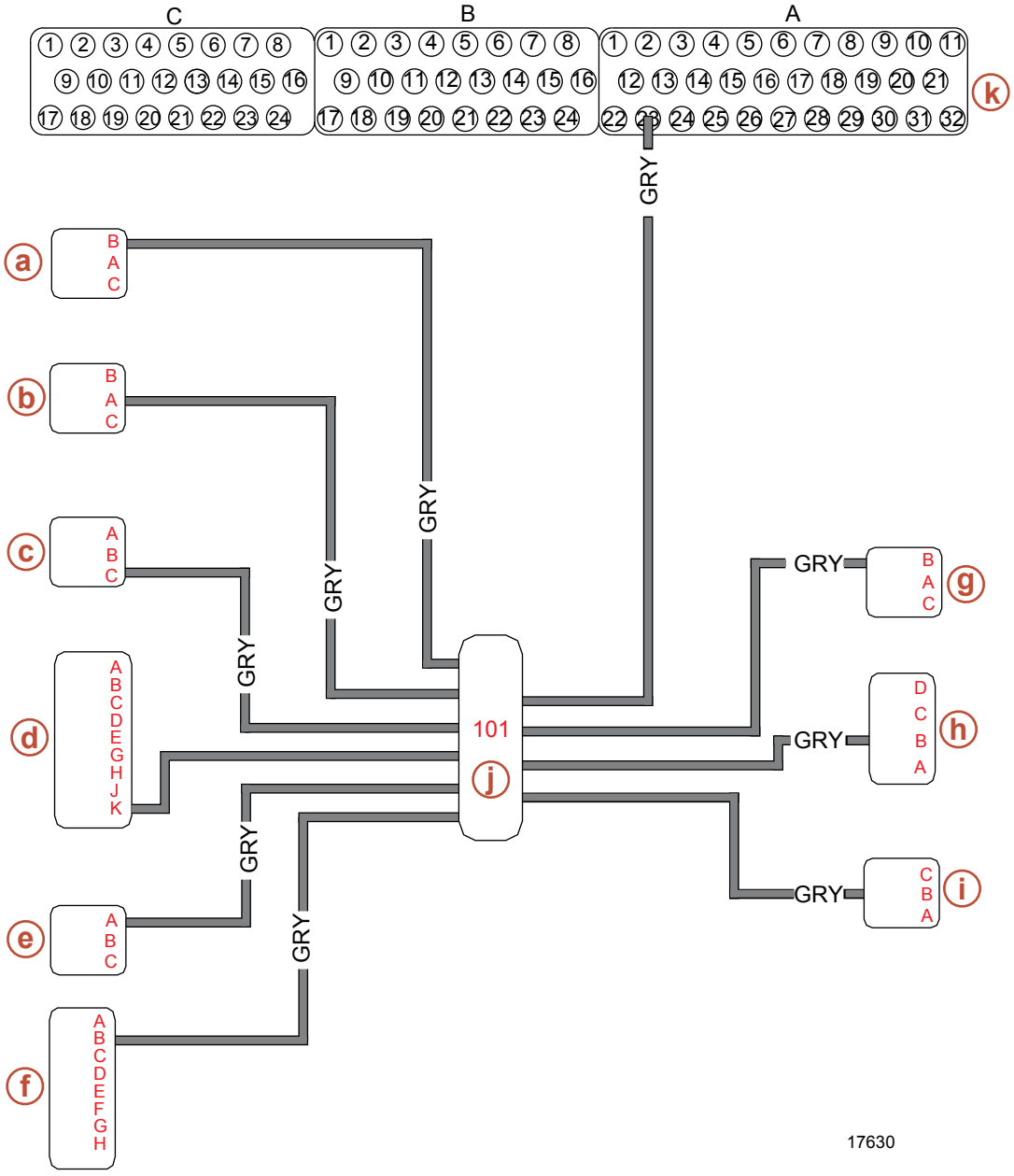
This is a general description of the positive current flow from the battery through the system until the starter motor cranks.

NOTE: *Ensure that all connections are tight and have the required resistance.*

- Battery to the starter solenoid switch on the starter (RED battery cable).
- Starter solenoid switch to circuit breaker (RED).
- Circuit breaker to wire junction (RED/PUR).
- Wire junction to wiring harness plug (RED/PUR) Terminal 6.
- Wiring harness plug to 20 amp fuse (RED/PUR).

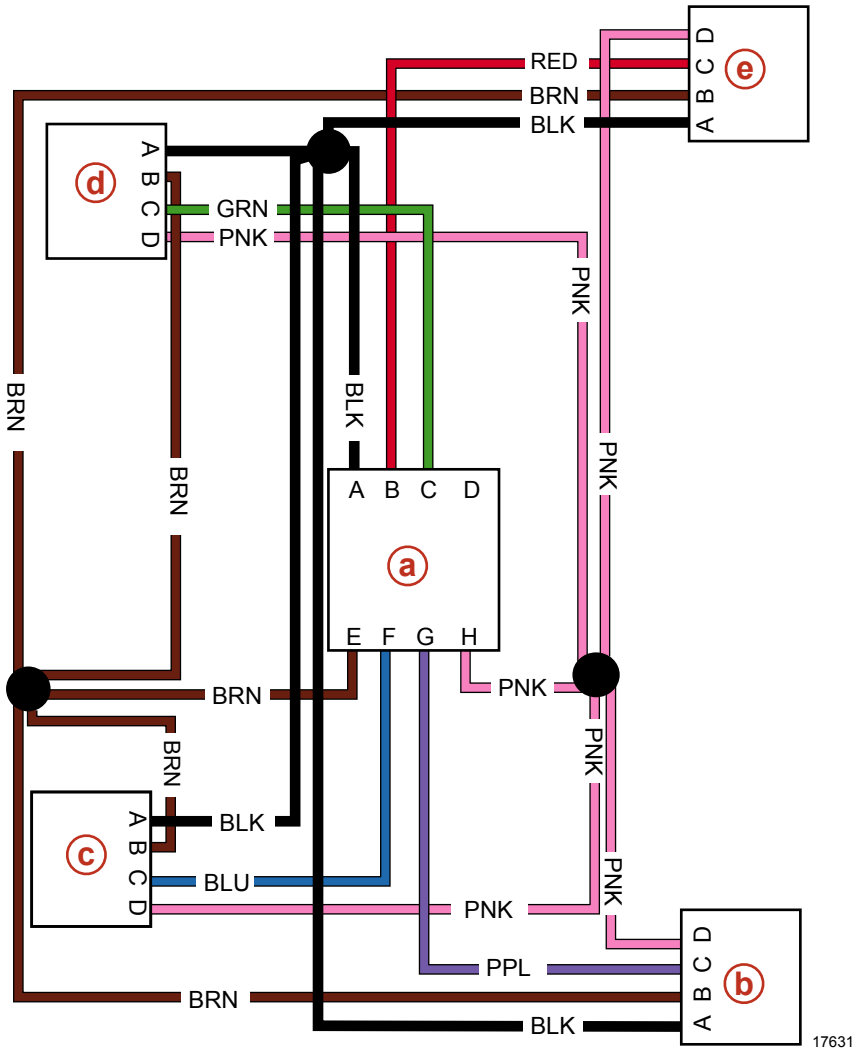
- 20 amp fuse to the ignition switch Terminal B (RED/PUR). At this point ignition switch is turned to the START position.
- Ignition switch Terminal B to Terminal S.
- Ignition switch Terminal S to neutral start switch (YEL/RED). **Neutral start switch must be at neutral position.**
- Neutral start switch to wiring harness plug Terminal 7 (YEL/RED).
- Wiring harness plug to starter solenoid (small terminal) (YEL/RED). Also, ensure that BLK (small terminal) wire is grounded.
- Starter solenoid is now CLOSED, completing circuit between large terminal (RED/PUR) and other large terminal (YEL/RED), causing starter motor to crank.

5 Volt Sensor Circuit—Integrated



a - Seawater pump pressure
b - TPS
c - MAP
d - TABS
e - Crankshaft position
f - Smart Transom (harness 865457A02 only)
g - Oil pressure
h - Paddle wheel
i - Camshaft position
j - Splice 101
k - PCM connector A

Coil Harness Circuit—496/8.1

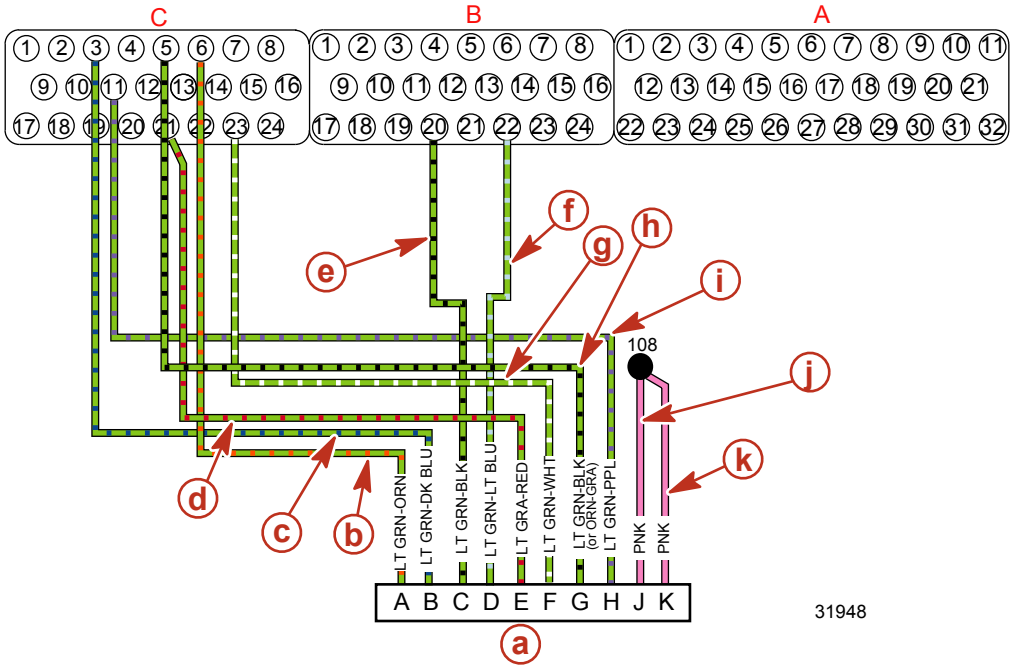


a - Coil Harness To Engine Harness Connector
b - 1 And 8 Coil Connector
c - 3 And 6 Coil Connector
d - 5 And 4 Coil Connector
e - 7 And 2 Coil Connector

There are 2 coil harnesses on the engine, one for each side of the engine. The harnesses are wired identically. The signal wire color for coils 1 and 8 is PPL, coils 3 and 6 is BLU, 5 and 4 wire is GRN, and 7 and 2 is RED The PNK wire is 12 volt power, the BRN wire is EST return and the BLK wire is ground. If a possible problem is suspected in the ignition system, check for faults once with key ON and once with engine running. An EST Open will only register a fault in a key ON only state and an EST Short will only register with the engine operating.

A malfunction in the coil harness will set the fault of EST 1-8 Open or EST 1-8 Short.

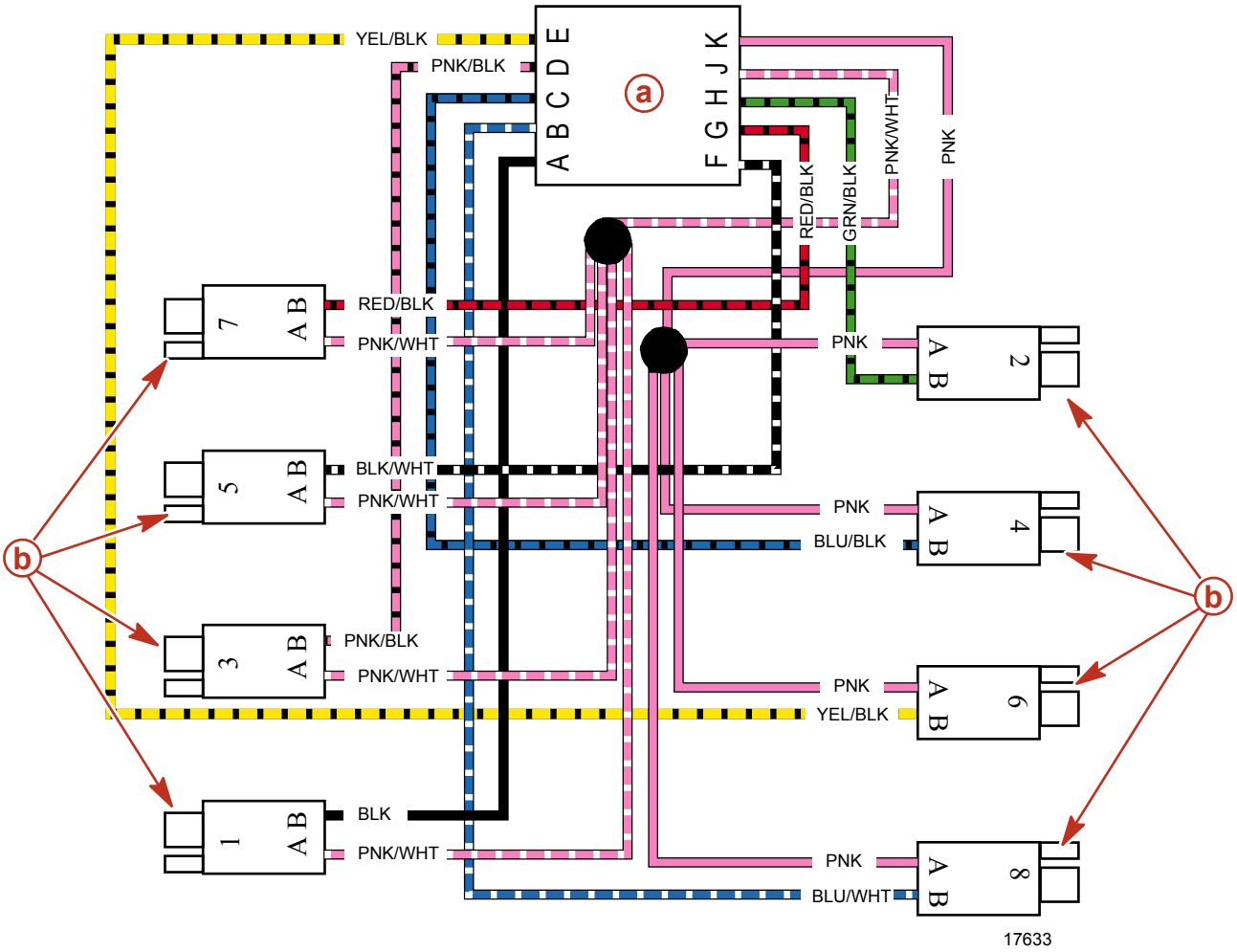
Fuel Injector Circuit (Engine Harness)—Harness 84-865457A02 and 84-865457A05



a - Engine harness to fuel injector harness connector
b - Injector 1
c - Injector 8
d - Injector 6
e - Injector 4
f - Injector 3
g - Injector 5
h - Injector 7
i - Injector 2
j - 12 Volt fused power to injectors (splice 108)
k - 12 Volt fused power to injectors (splice 108)

The fuel injectors receive fused 12 volt power on pins J and K of the engine harness connector from the splice 108. The PCM signals the injectors to activate by pulling the 12 volt to ground and completing the circuit through the engine harness and injector harness.

Fuel Injector Circuit (Injector Harness)



a - Injector harness to engine harness connector

b - Individual injector connectors

The fuel injectors receive fused 12 V power from splice 108 (pins J and K) on the injector harness. The PCM signals the injector to fire by pulling the 12 V to ground and completing the circuit. The normal resistance value of one injector at 21° C (70° F) is 12.5 ohms.

A malfunction in the fuel injector harness will set the fault of FINJ 1-8 Open or FINJ 1-8 Short.

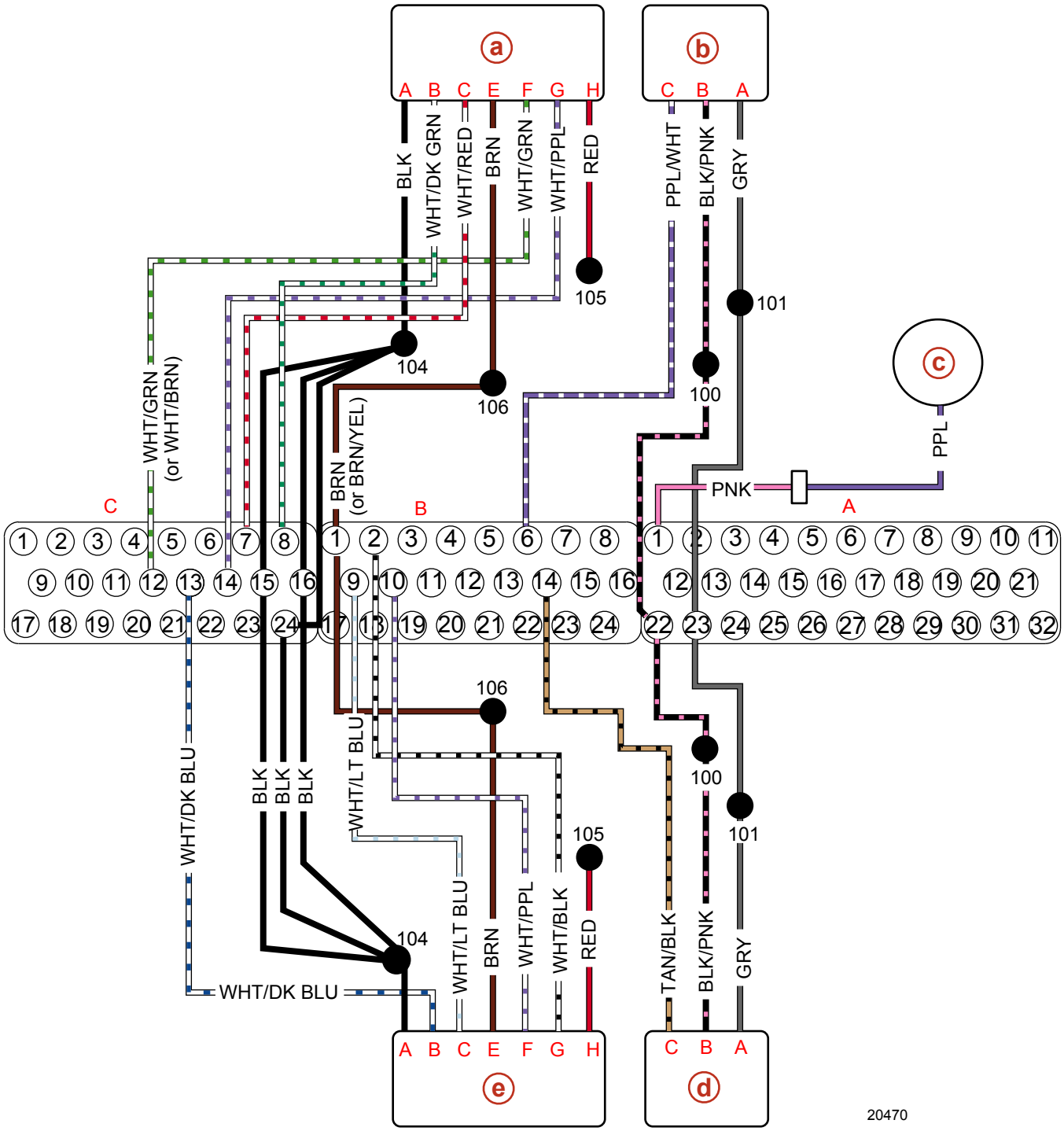
If the fuel injector driver wire has shorted to ground, the scan tool reads Open Sensor, meaning that the fuel injector circuit is full Open.

The scan tool reads Short Injector if a fuel injector has a short circuit.

A 12 V fuel injector power lead with a short circuit will blow the injector fuse E-F; the scan tool will read Bad Fuel Pump Fuse.

Fuel Injector Number	Wire Colors on Fuel Injector Harness	PCM Pinout
1	BLK	C-6
2	GRN/BLK	C-11
3	PNK/BLK	B-22
4	BLU/BLK	B-20
5	BLK/WHT	C-23
6	YEL/BLK	C-21
7	RED/BLK	C-5
8	BLU/WHT	C-3

Ignition Circuit

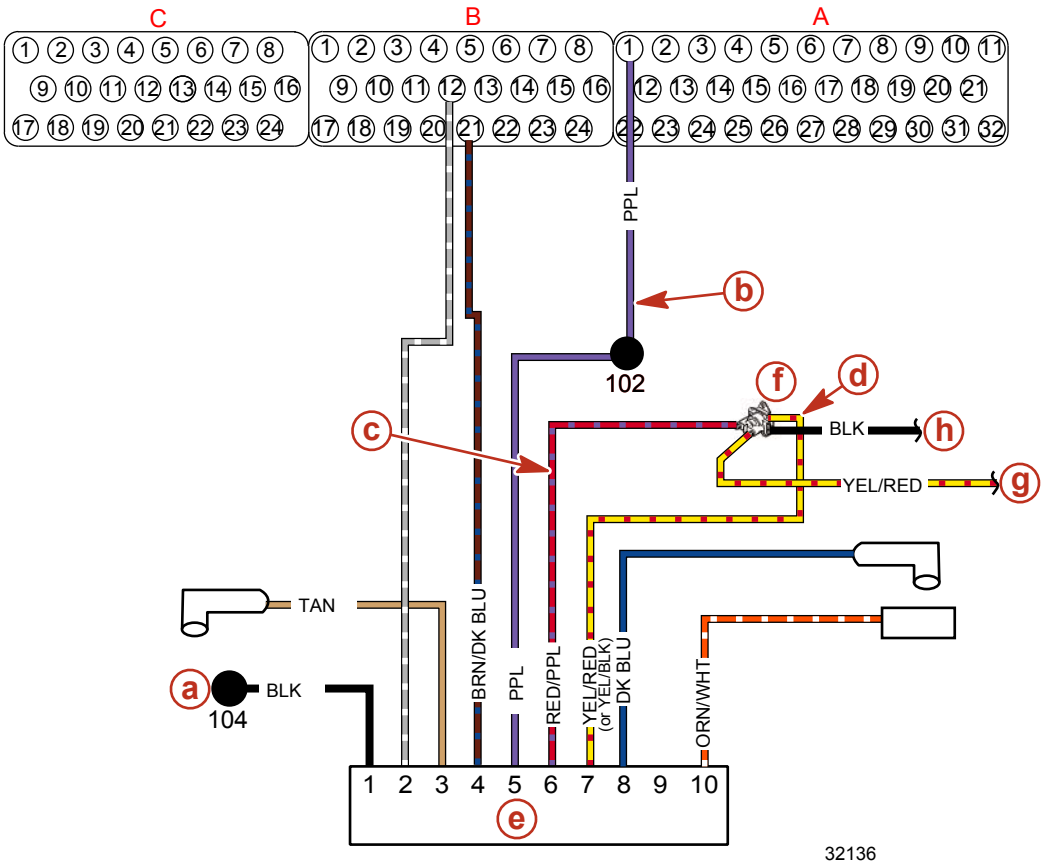


a - Coil trigger (even)
b - Cam position sensor (CMP)
c - Key switch
d - Crankshaft position sensor (CPS)
e - Coil trigger (odd)

With initial key on, 12 volt power is sent from the battery through the purple lead in the 10-pin harness to the pink lead at Engine Harness Pin C. This is wake up power to the PCM. The PCM powers pin B4 which in turn pulls the MPR low. The MPR powers the coils through Splice 105 and powers the engine for ignition.

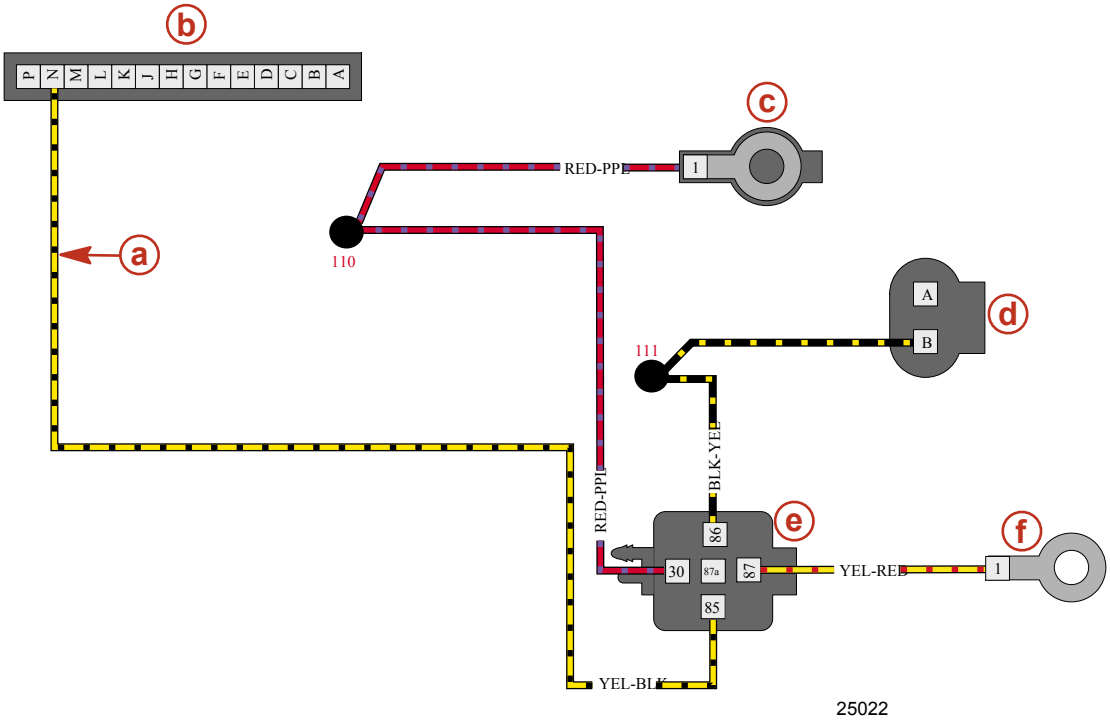
PCM Pinout	Cylinder	PCM Pinout	Cylinder	PCM Pinout	Cylinder
B2	1	C8	2	B9	5
C7	4	C13	7	C14	8
B10	3	C12	6		

Start Circuit with Start Solenoid Relay



a - Ground (–)
b - Wakeup
c - Circuit breaker, 50A
d - Key switch terminal "S" or neutral safety switch
e - 10 Pin connector
f - Start solenoid relay
g - Starter "S" stud
h - Ground (–)

Start Relay Circuit—Mechanical

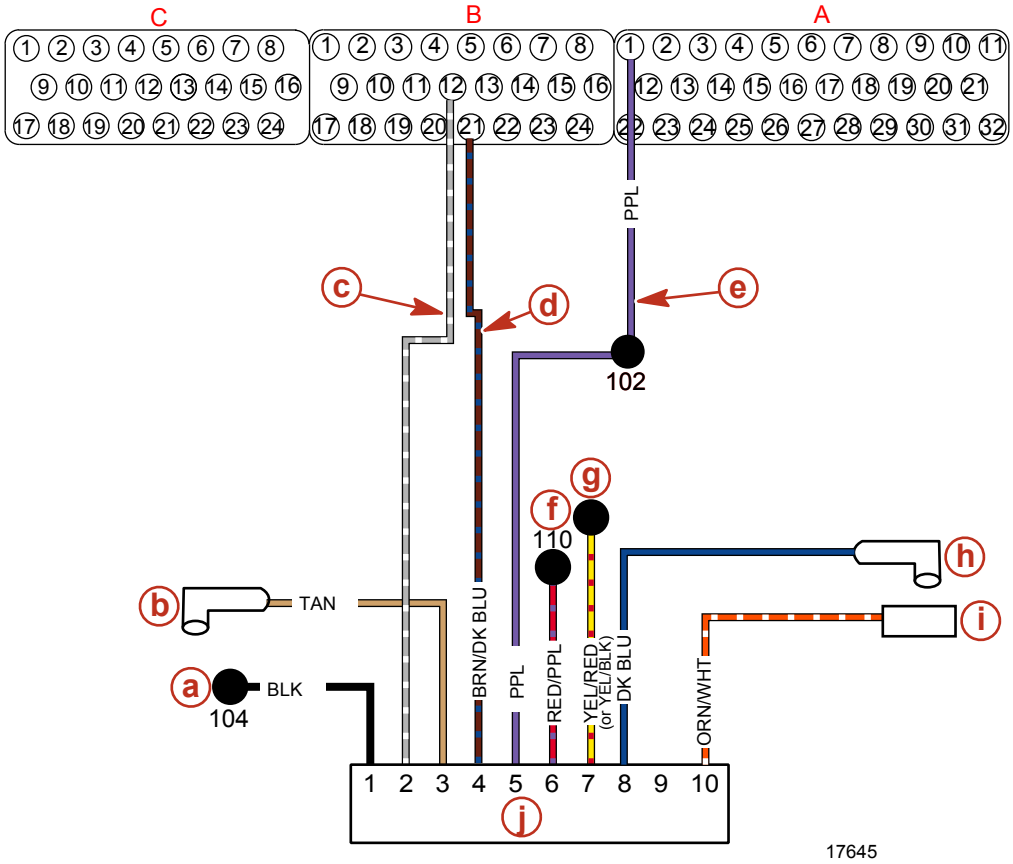


a - Power from key switch through 14 pin connector
b - 14 Pin connector
c - Circuit breaker, 50A
d - Gear position
e - Starter relay
f - Starter "S" stud

Single Circuit Diagrams

This section outlines the circuitry of the wiring harness and sensors as individual systems. This allows for a quick reference point when trying to detect a faulty connection. However, the complete system wiring diagram should be referenced if multiple electrical faults are occurring.

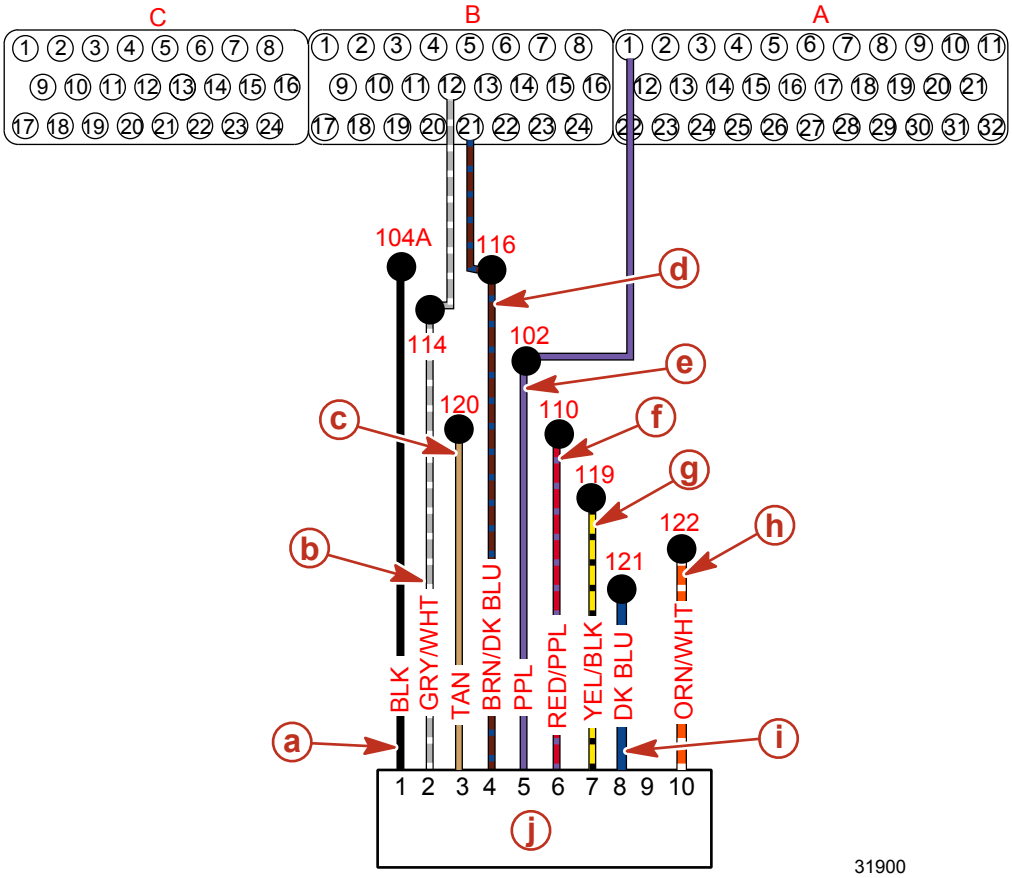
10 Pin Harness Circuit—84-865457A01 and 84-865457A02



a - Ground (–)
b - Analog coolant
c - Tachometer signal
d - Audio warning horn
e - Key on power (wake up)
f - Power to helm
g - Crank request
h - Analog oil pressure
i - Analog trim
j - 10 Pin connector

A malfunction of the 10 pin harness connection will not set a fault.

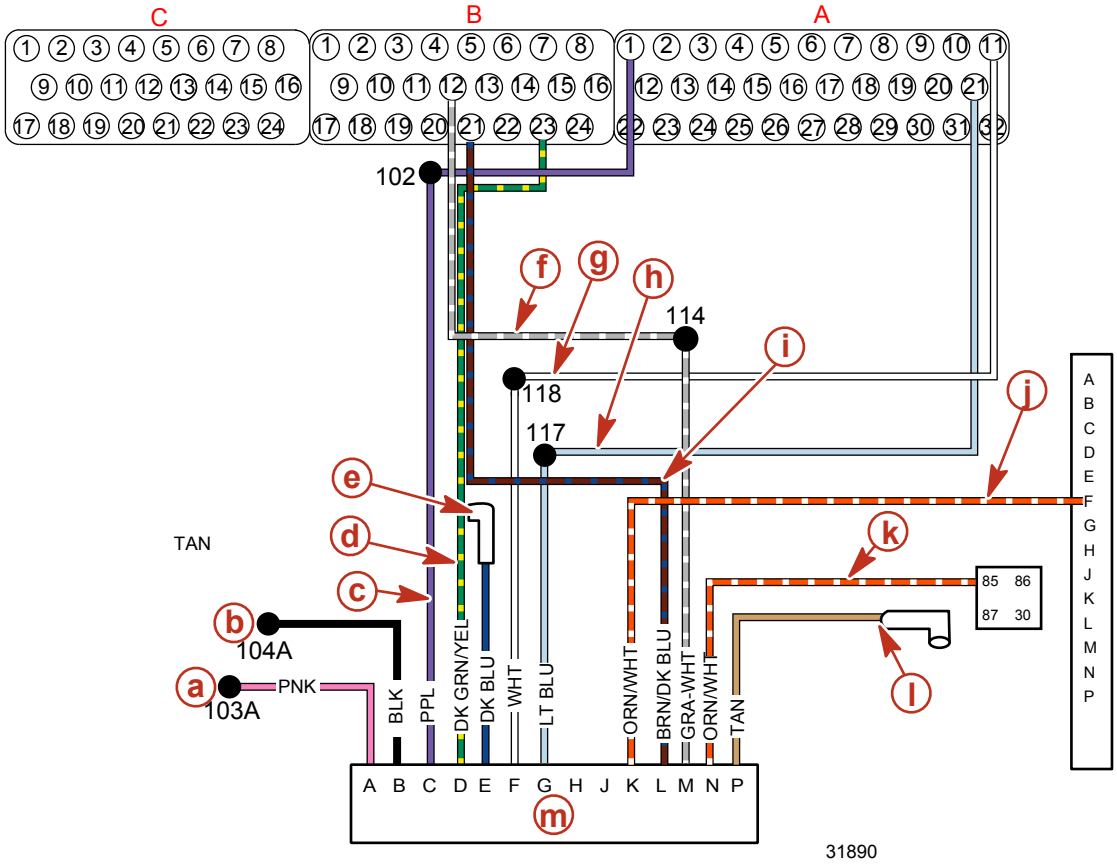
10 Pin Harness Circuit—84-865457A05



a - Ground (–)
b - Tachometer signal
c - Splice 120 (to analog coolant pressure)
d - Audio warning alarm
e - Wake
f - Power to helm
g - Splice 119 (to start relay—crank request)
h - Splice 122 (to analog trim)
i - Splice 121 (to analog oil pressure)
j - 10 Pin connector

A malfunction of the 10 pin harness connection will not set a fault.

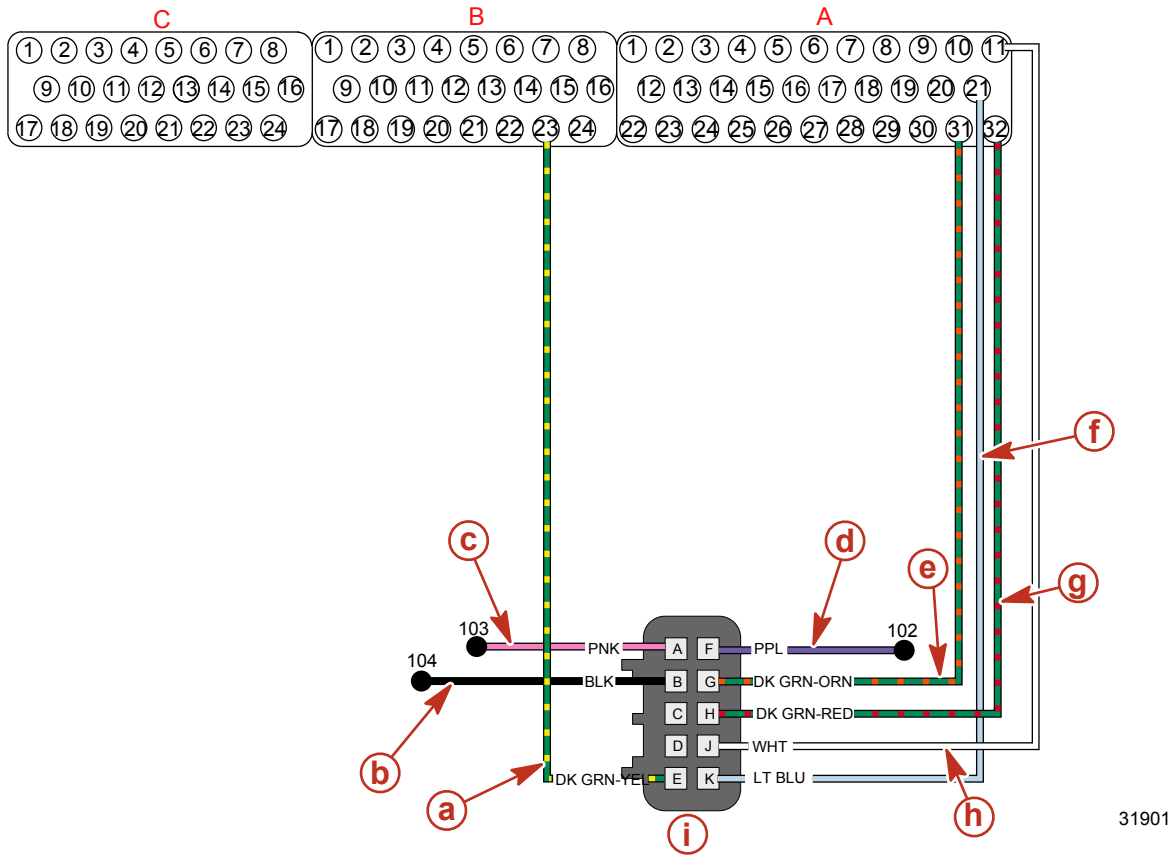
14 Pin Harness Circuit—84-865457A05



a - Power to helm
b - Ground (–)
c - Key on power (wake up)
d - E-stop
e - Analog oil pressure
f - Tachometer signal
g - CAN 1 +
h - CAN 1 –
i - Audio warning horn
j - Analog trim
k - Crank request
l - Analog coolant
m - 14 Pin connector

A malfunction of the 14 pin harness connection will not set a fault.

Control Area Network (CAN) Circuit—Harness 84-865457A02

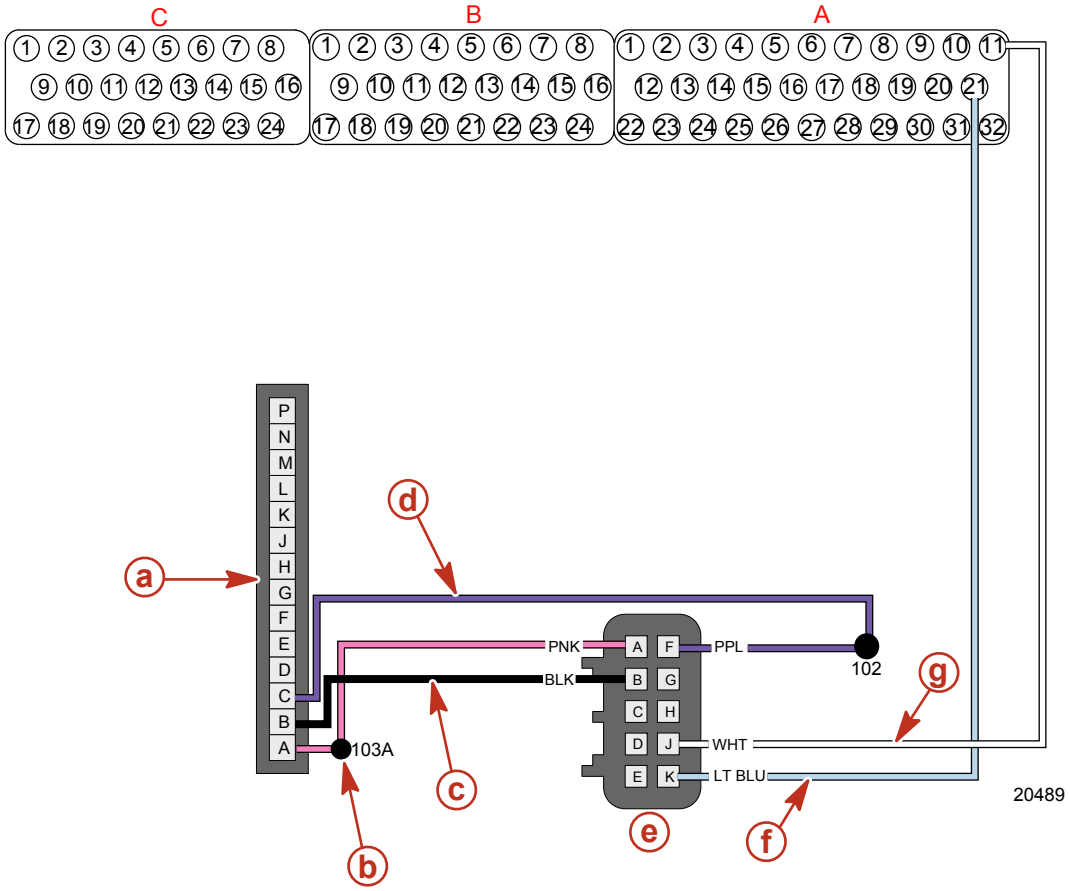


a - E-stop
b - Ground (–)
c - 12 Volt power to helm
d - Wake up line
e - CAN 2 positive (+)
f - CAN 1 negative (–)
g - CAN 2 negative (–)
h - CAN 1 positive (+)
i - CAN terminator

The CAN circuit powers all SmartCraft gauges and system view on mechanical throttle and shift engines. It is located on the front of the engine on the upper port side. The gauges receive power through the bus power and ground. Gauge information (RPM, temperature, trim) is sent through the CAN leads.

A malfunction in the CAN circuit will not set a fault.

Control Area Network (CAN) Circuit—Harness 84-865457A05

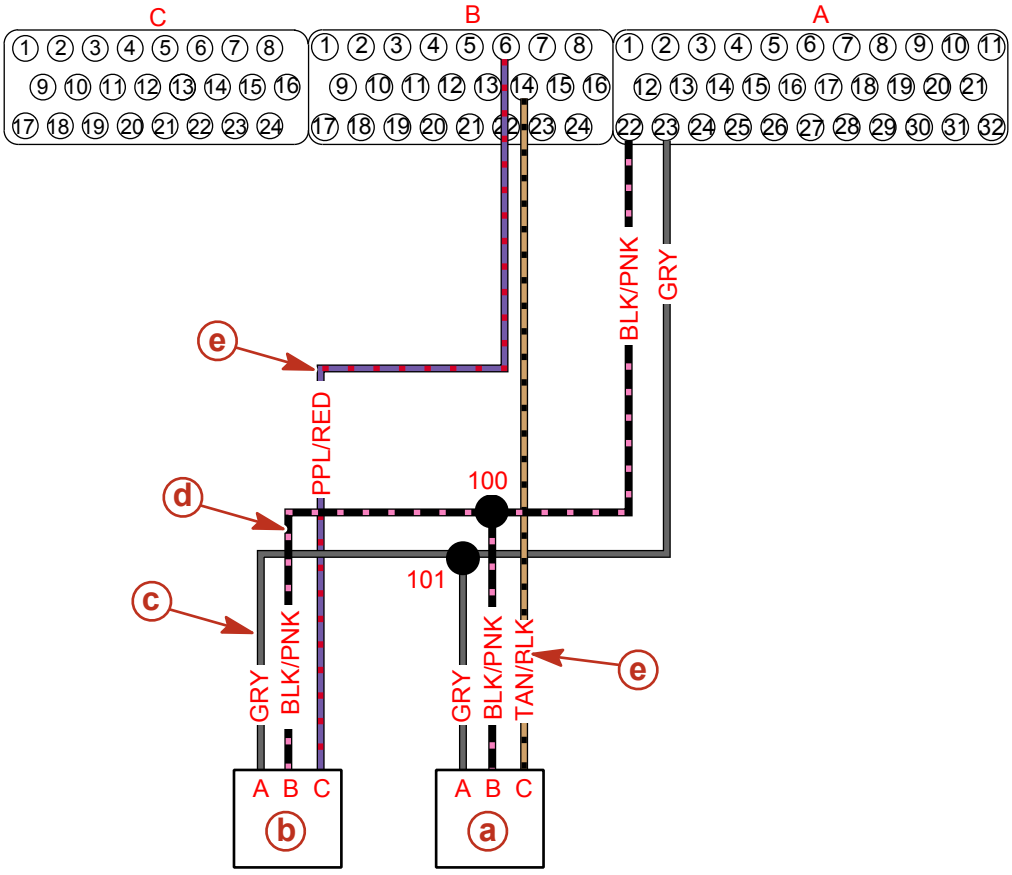


a - 14 Pin connector
b - 12 Volt power to helm
c - Ground (–)
d - Wake Up Line
e - CAN terminator
f - CAN 1 negative (–)
g - CAN 1 positive (+)

The CAN circuit powers all SmartCraft gauges and system view on mechanical throttle and shift engines. It is located on the front of the engine on the upper port side. The gauges receive power through the bus power and ground. Gauge information (RPM, temperature, trim) is sent through the CAN leads.

A malfunction in the CAN circuit will not set a fault.

Crank Position and Camshaft Position Circuits



a - Crankshaft position sensor (CPS)
b - Camshaft position sensor (CMP)
c - 5 Volt power
d - 5 Volt ground
e - Signal to PCM

The crankshaft position sensor (CPS) is located at the timing chain cover on the front of the engine. It is a three-wire, Hall Effect sensor that keeps track of the crankshaft position and engine RPM. Signals are created in the sensor by a four-vane reluctor wheel mounted on the end of the crankshaft, behind the timing chain cover, that rotates past the sensor. The CPS signals to the PCM 555 that the crankshaft is positioned with pistons 1 and 6, 8 and 5, 4 and 7, or 3 and 2 at TDC. It can not tell which one of each pair is on the compression stroke and which one is on the exhaust stroke.

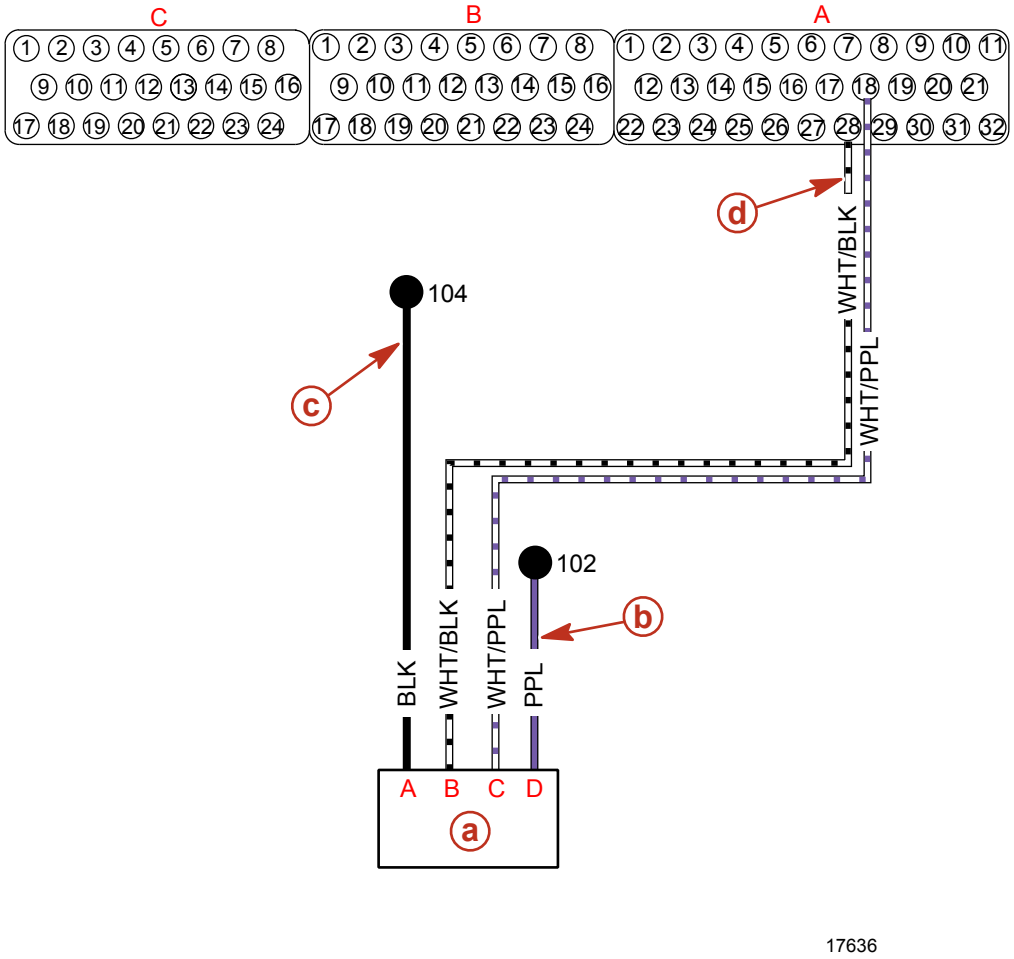
If the CPS pulses are not present the engine will not run.

The camshaft position sensor (CMP) is mounted inside of the high voltage switch (HVS) [distributor]. It is installed on all DTS engines that use this ignition system. It is a three-wire, Hall Effect sensor. The CMP signal is compared with the CPS signal by the PCM 555. This allows the PCM 555 to determine which one of each pair of pistons (1 and 6, 8 and 5, 4 and 7, or 3 and 2) is at TDC, on the compression stroke. This information is used to provide extra control of the eight fuel injector drivers and the ignition system, and to more accurately report engine knock information to the PCM 555.

The lack of a CMP signal may result in a longer crank time since the PCM cannot determine the cycle of the piston stroke.

A malfunction of the CPS or the CMP will not set a fault..

Diagnostics Circuit



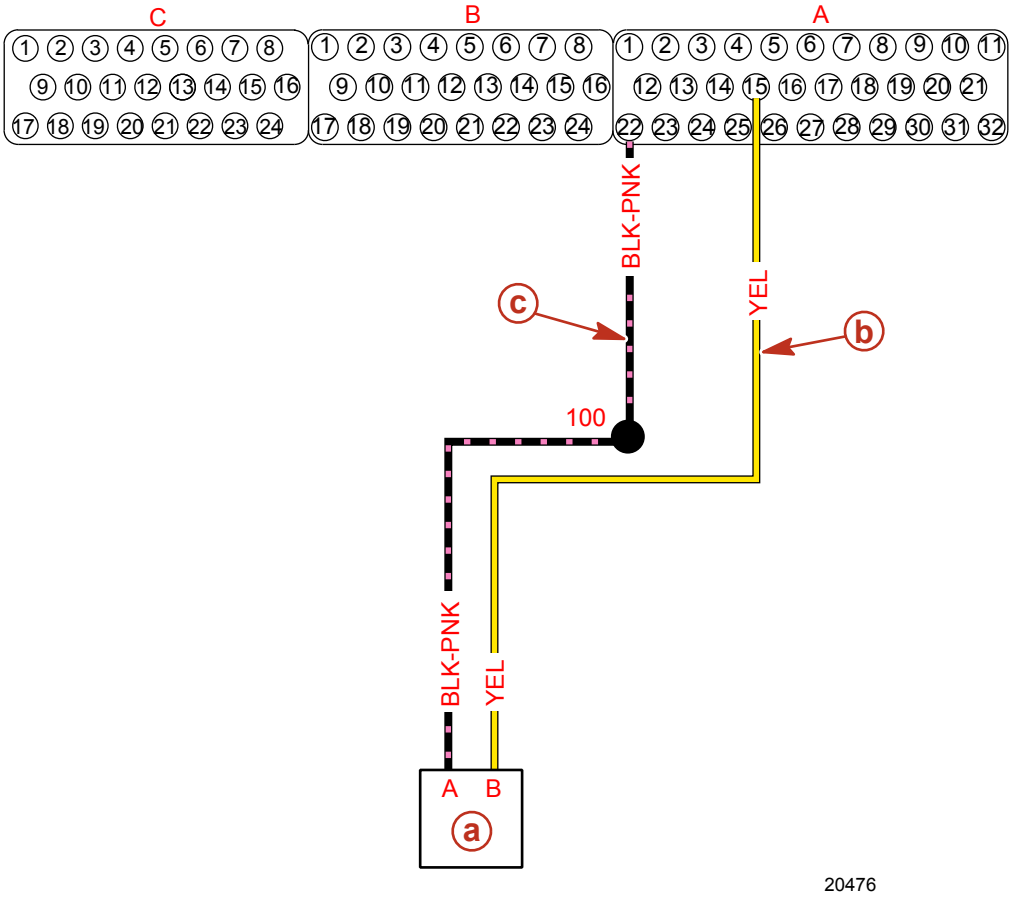
a - Data link connector
b - 12 Volt switched power
c - 12 Volt ground
d - Data leads from PCM

The data link connector (DLC) is a 4 pin circuit for attaching the diagnostic tool to the PCM. It is located on the port side of the engine next to the oil filter. Before attaching a diagnostic tool to the engine, verify that the key is OFF and the pins are clean of corrosion and debris. Pin A is the 12 volt ground connected to the engine harness at splice 104. Pins B and C are data retrieval lines from the PCM. Pin D is the 12 volt supply to the diagnostic tool.

IMPORTANT: Diagnostic tools can only receive data with key ON or engine operating. Diagnostic tools need a minimum of 8 volts. If the diagnostic tool does not respond, verify the connection, verify that the key is ON and check the battery voltage.

A malfunction of the data link connector will not set a fault.

Engine Coolant Temperature Sensor (ECT) Circuit



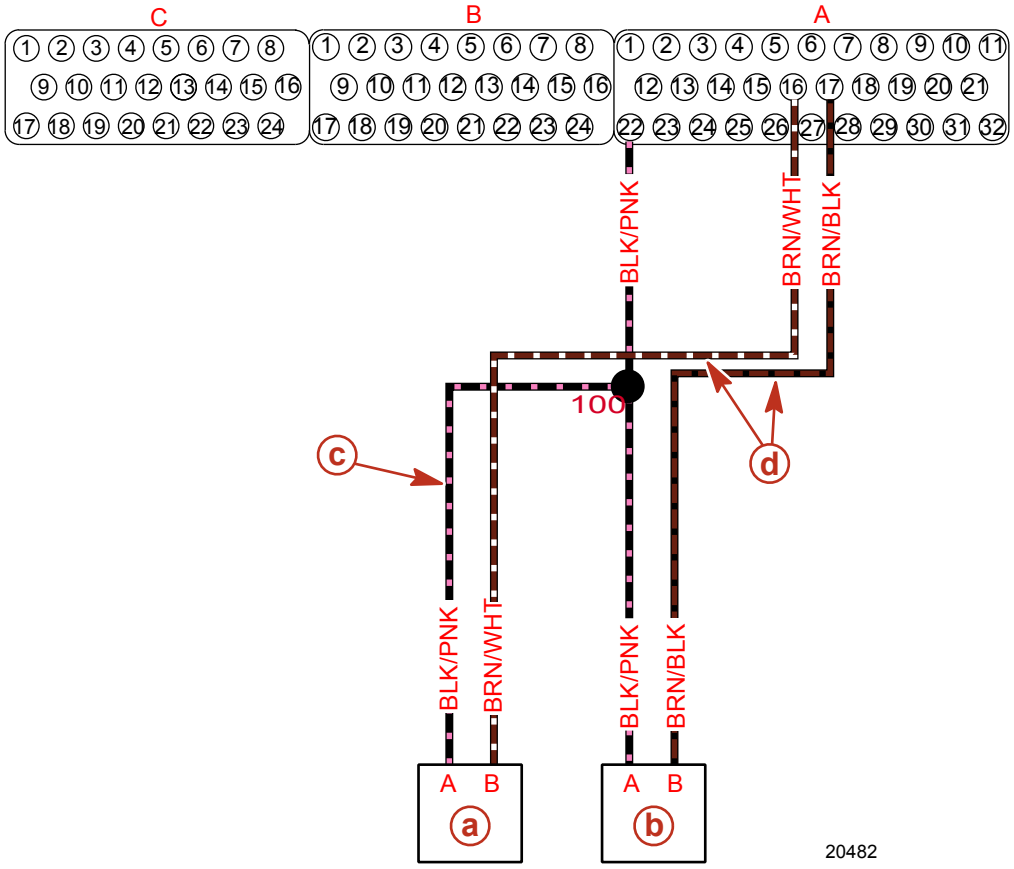
a - Engine coolant temperature sensor (ECT)
b - 5 Volt signal wire
c - 5 Volt transducer ground

The engine coolant temperature sensor (ECT) is a thermistor immersed in the engine coolant stream. It is located in the water crossover on the front starboard side of the engine. Low coolant temperature produces high resistance, while high temperature causes low resistance. The normal resistance value for the ECT sensor at 21° C (70° F) is 3.12 kOhms.

A malfunction of the ECT sensor will set a fault of Cool TEMP CKT Hi, Cool TEMP CKT Lo or ECT Coolant Overheat.

Approximate Temperature-To-Resistance Values		
° F	**° C**	**ohms**
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Exhaust Manifold Coolant Temperature Sensor (EMCT) Circuits

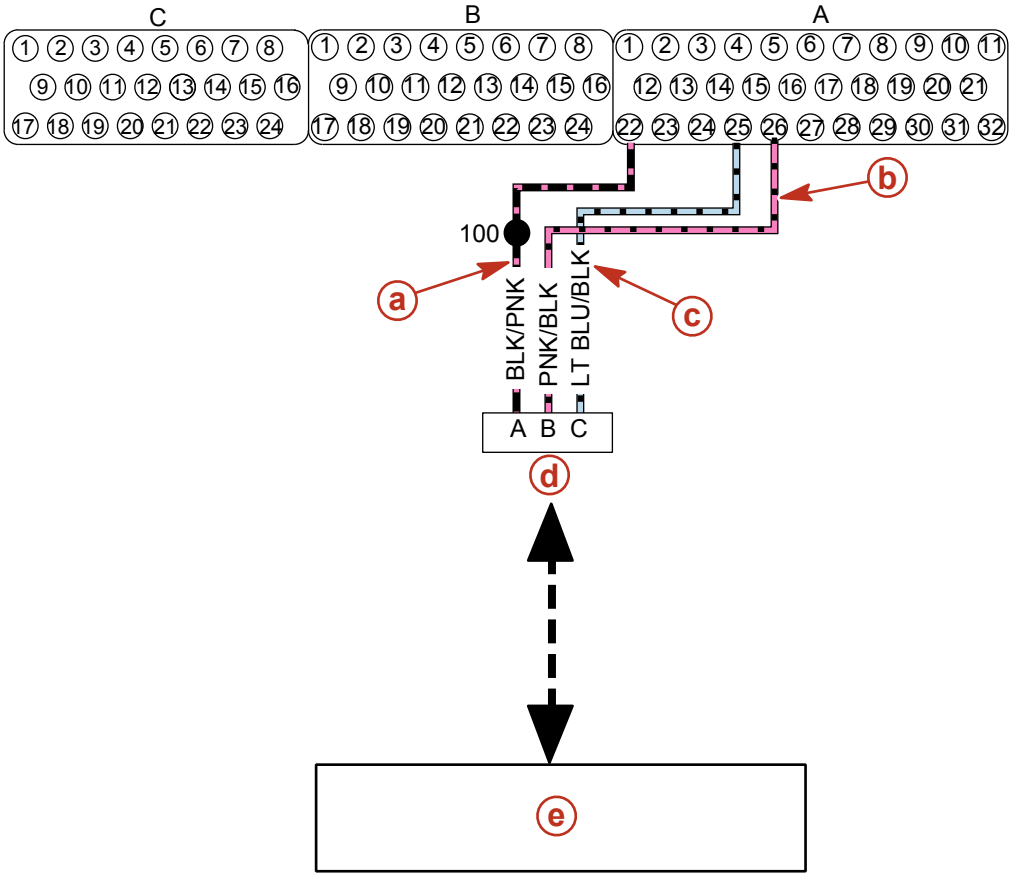


a - Port exhaust manifold coolant temperature sensor (EMCT)
b - Starboard exhaust manifold coolant temperature sensor (EMCT)
c - 5 Volt transducer ground (–)
d - Signal to the PCM

The exhaust manifold coolant temperature (EMCT) sensors are located on the top of each exhaust manifold. The EMCT sensors are thermistors immersed in the engine exhaust stream. Low temperatures produce high resistance, while high temperatures cause low resistance.

A malfunction of the EMCT will set a fault of Port EMCT CKT Hi, Port EMCT CKT Lo, Port EMCT CKT Overheat, STB EMCT CKT Lo, STB EMCT CKT Hi or STB EMCT CKT Overheat.

Fuel Level Sensor Circuit—Harness 84-865457A02



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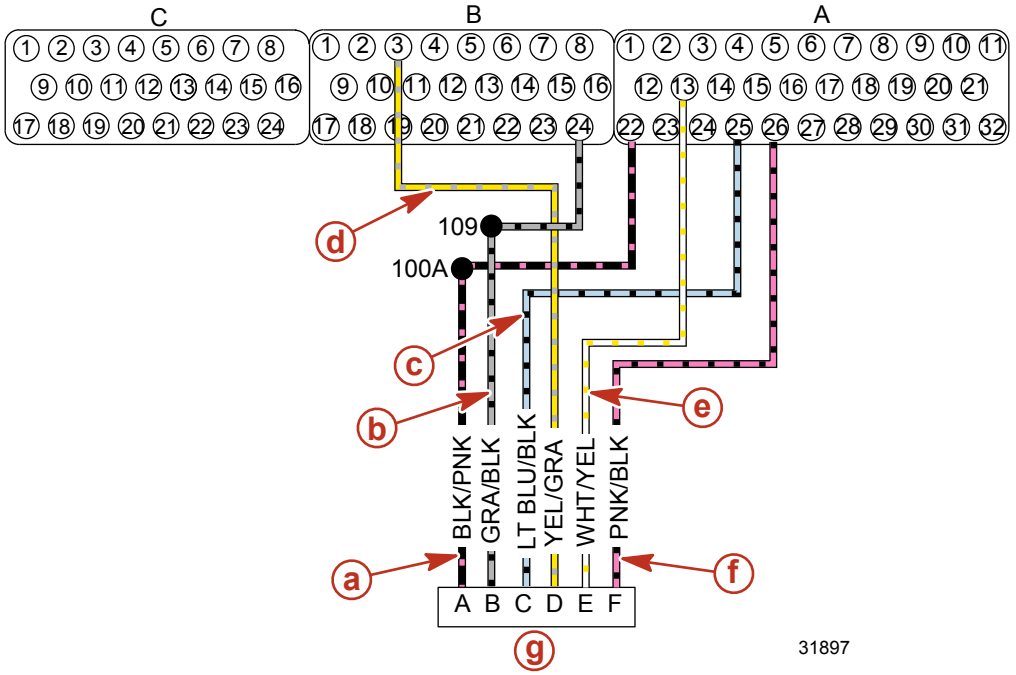
a - 5-volt transducer ground
b - Fuel level 1
c - Fuel level 2
d - Connector—fuel level
e - Extension harness

The fuel level sensor circuit supplies the PCM with the fuel level. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Level Sensor Circuit—Harness 84-865457A05 and 84-865457A06

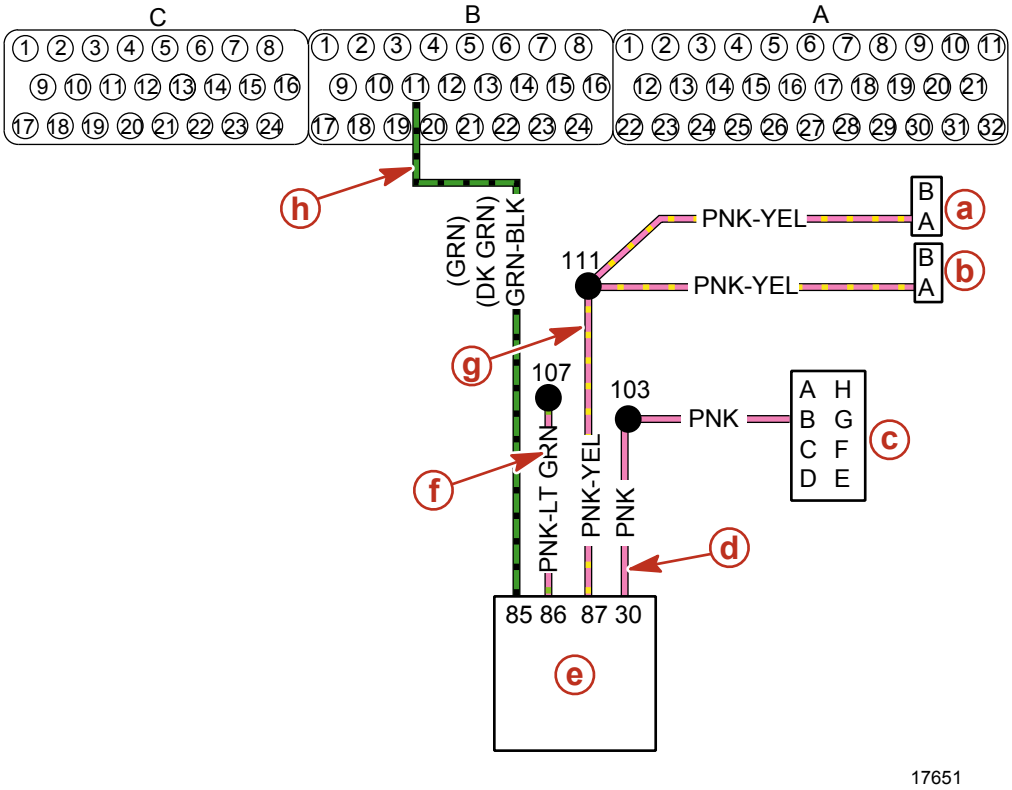


a - 5 Volt transducer ground
b - Power 2 (SmartCraft sensors)
c - Fuel level 2
d - Paddle wheel signal
e - Seawater temperature signal
f - Fuel level 1
g - 6 Pin connector

The fuel level sensor circuit supplies the PCM with fuel level information. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Pump Relay Circuit

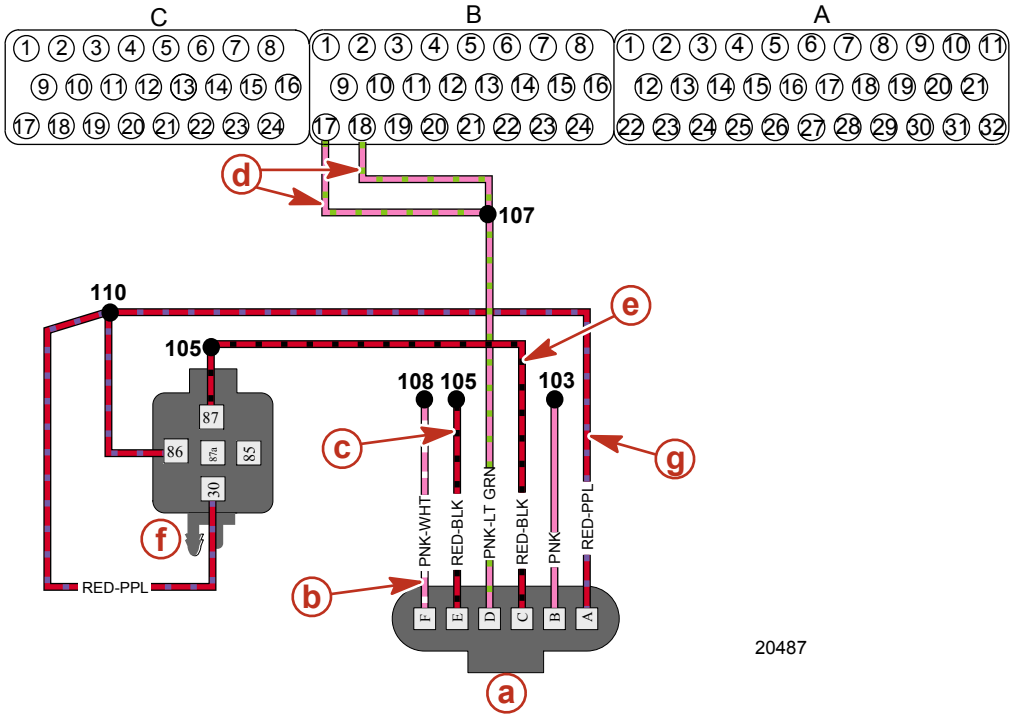


a - Cool fuel pump
b - Boost fuel pump (if equipped)
c - Fuses
d - 12 Volt power from the fuses
e - Fuel pump relay
f - 12 Volt power from fuses (cavity D)
g - 12 Volt power to fuel pump
h - Signal from PCM

When the key switch is turned to the on position, the fuel pump relay receives 12v battery power through the fuses at terminal 86 and 30. The relay powers both fuel pumps.. Listen at key on for both fuel pumps to operate.

A malfunction in the fuel pump relay circuit will not set a fault.

Fuse Circuit—Harness 84-865457A02



a - Fuses

b - To splice 108—12 volt fused power, trim relay, IAC and injectors

c - To splice 105—switched 12 volt power, MPR

d - To splice 107—12 volt fused power, PCM

e - To splice 105—switched 12 volt power, MPR

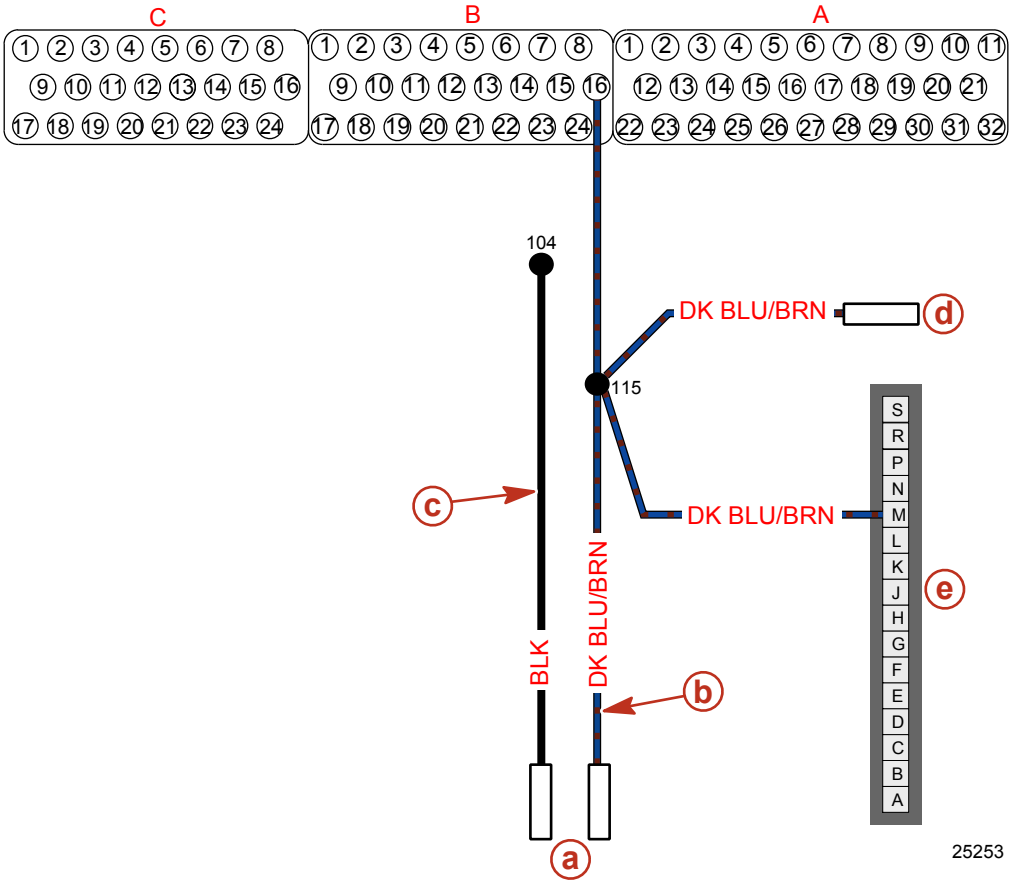
f - Main power relay (MPR)

g - To splice 110—50 A protected, 12 volt battery power

The fuse circuit receives 12 volt power through Splices 110 and 105. The fuse circuit is located on the upper port side of the engine. The protected power is then sent to the PCM, fuel injectors, and fuel pump relay.

A malfunction in the fuse circuit will not set a fault.

Gear Lube Monitor and Transmission Over-Temperature Circuit

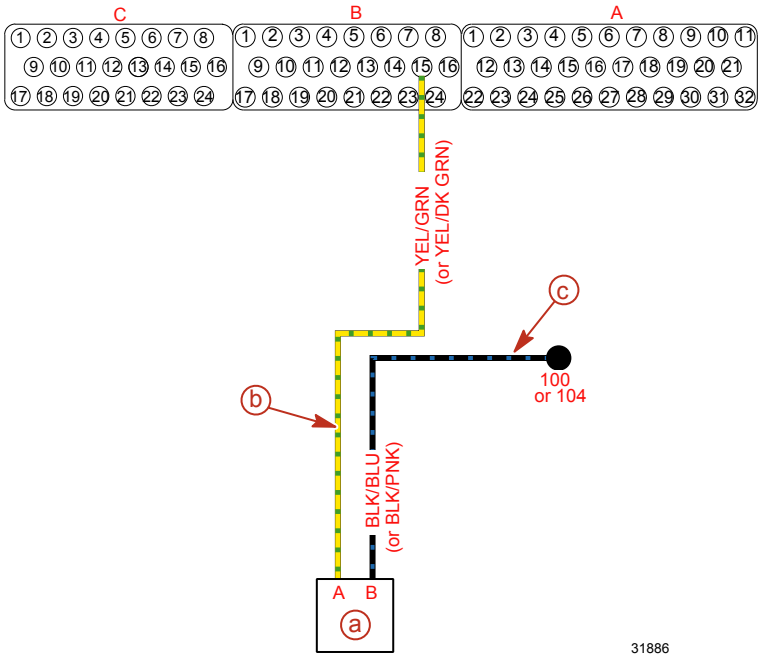


a - Drive gear lube monitor connectors—sterndrive
b - Signal wire
c - Ground (–)
d - Transmission temperature sensor connector—inboard
e - 16 Pin harness connector

The gear lube monitor or transmission over-temperature (overtemp) circuit is an open-continuity circuit. The circuit connector is located on the top, port side of the engine. The circuit will show continuity if the level of fluid in the gear lube monitor is low (sterndrive) or it the transmission temperature is excessive (inboard). If a problem is suspected, check continuity. There should be continuity with an empty gear lube monitor and no continuity with a full monitor (sterndrive) or no continuity with transmission temperature low and continuity if transmission temperature is excessive (inboard).

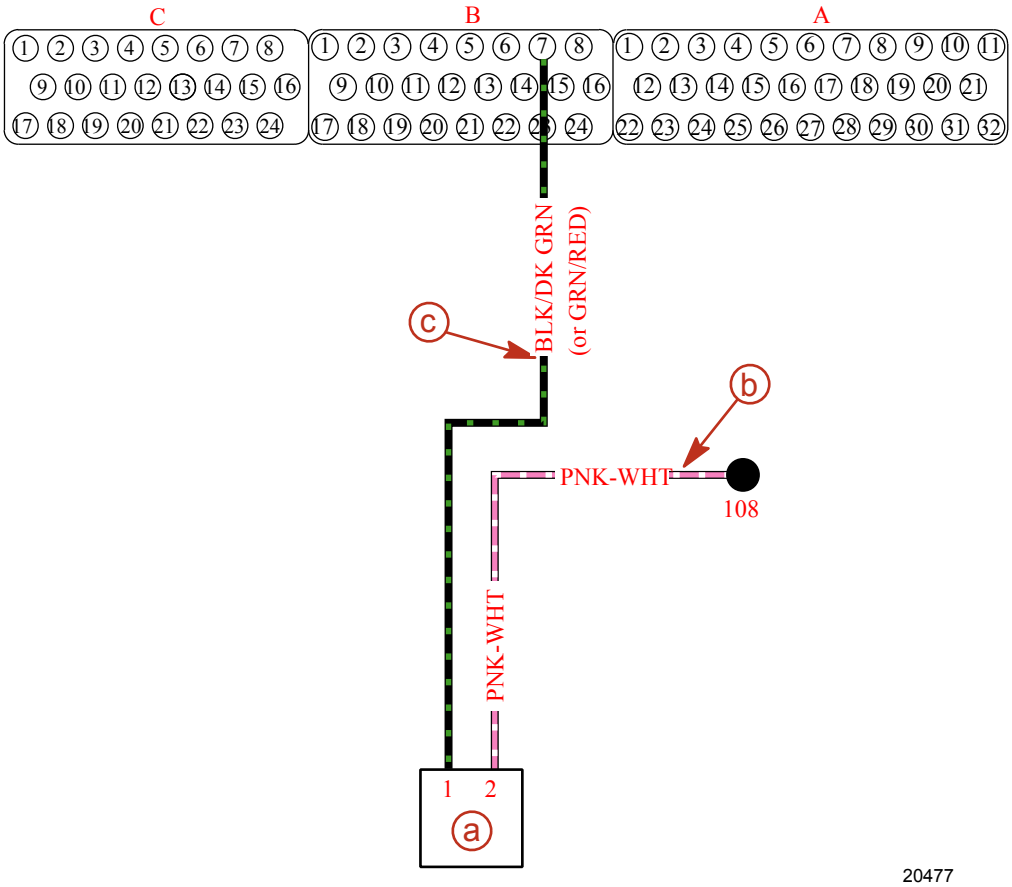
A low level of fluid in the gear lube monitor will set a fault of Low Drive Lube Strategy. Excessive transmission temperature will set a fault.

Gear Position Switch



a - Gear position switch connector
b - Signal wire
c - Ground (–)

Idle Air Control Valve (IAC) Circuit—Integrated



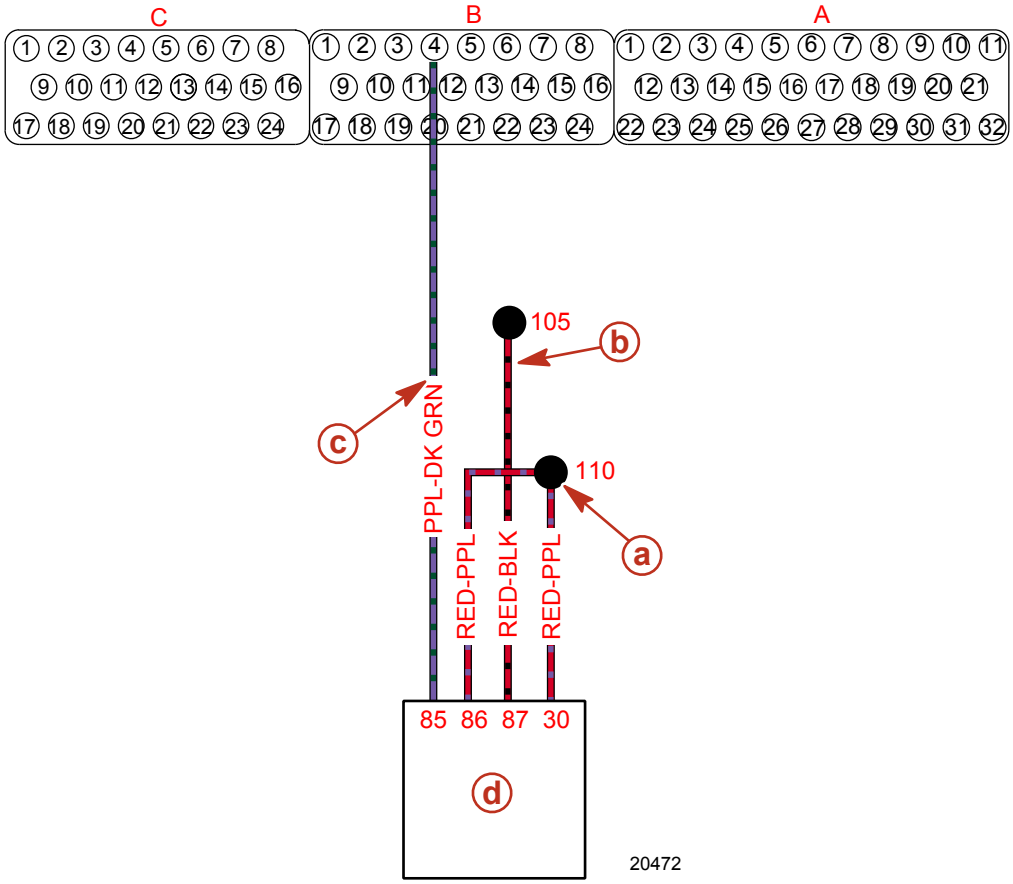
a - IAC sensor connector
b - 12 Volt transducer power from MPR
c - Signal wire

The idle air control valve (IAC) is a 12 volt circuit powered by the MPR. The IAC is located on top rear of the engine.

A malfunction of the IAC will set a fault of IAC Output.

The IAC circuit is not used with the DTS.

Main Power Relay Circuit—Serial Numbers OW000000 and Above

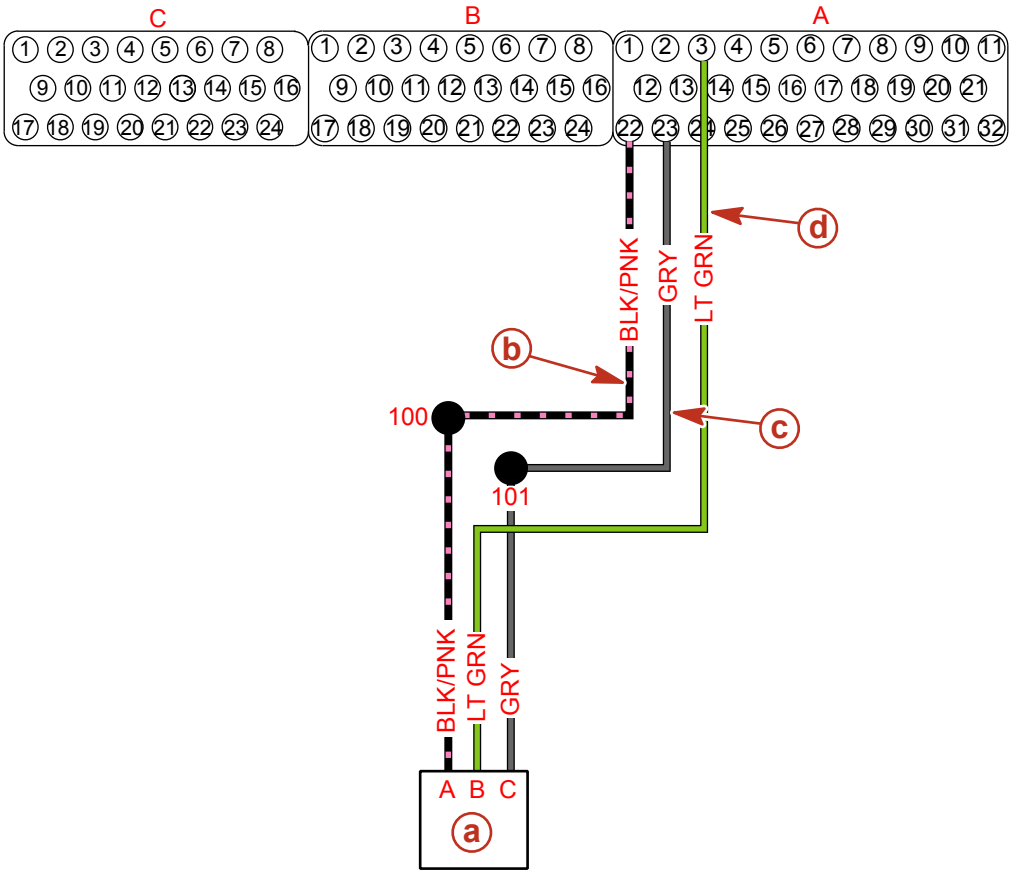


a - 50 A protected battery power
b - Output power to splice 105
c - Signal from PCM
d - MPR

When the key switch is in the on position the main power relay (MPR) is activated and sends 12 volt power to splice 105, which powers the IAC, fuel injectors, and part of the PCM. The MPR is located on the top of the engine near the PCM. Listen for a click on initial key on and check continuity to the MPR if a problem is suspected.

A malfunction of the MPR could result in the fault MPR Output or MPR Backfeed.

Manifold Absolute Pressure Sensor (MAP) Circuit

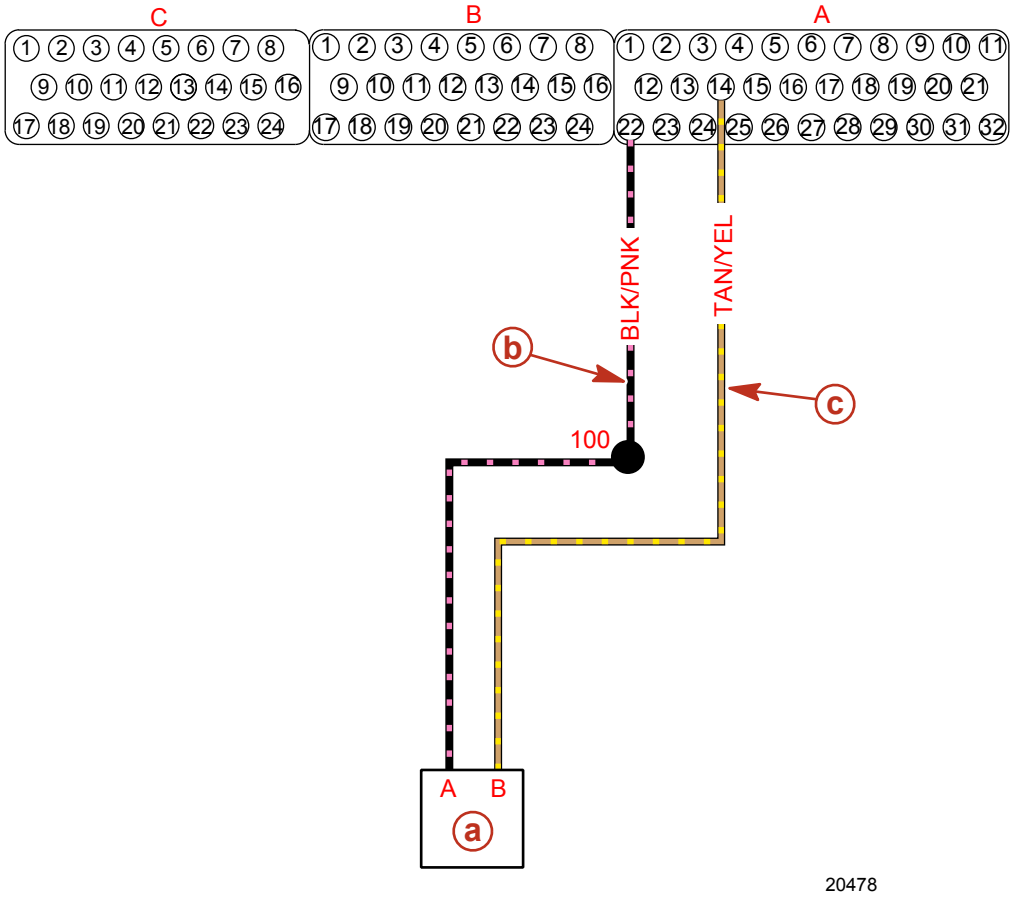


a - Manifold absolute pressure sensor (MAP) connector
b - 5 Volt ground
c - 5 Volt power
d - Signal Wire

The manifold absolute pressure sensor (MAP) measures the changes in the intake manifold pressure. It is located on the intake manifold on the top of the engine. At key on, the MAP is equal to atmospheric pressure. This information is used by the PCM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading with a known good MAP sensor is a good check of a suspect sensor. The pressure changes as a result of engine load and speed change. The PCM receives this information as a signal voltage that will vary from about 1.0-2.0 volts at idle to about 4.0-5.0 volts at WOT.

A malfunction in the MAP sensor circuit could set the fault of MAP Sensor Input HI, MAP Sensor Input Lo or MAP Sensor Idle Rationale.

Manifold Air Temperature Sensor (MAT) Circuit

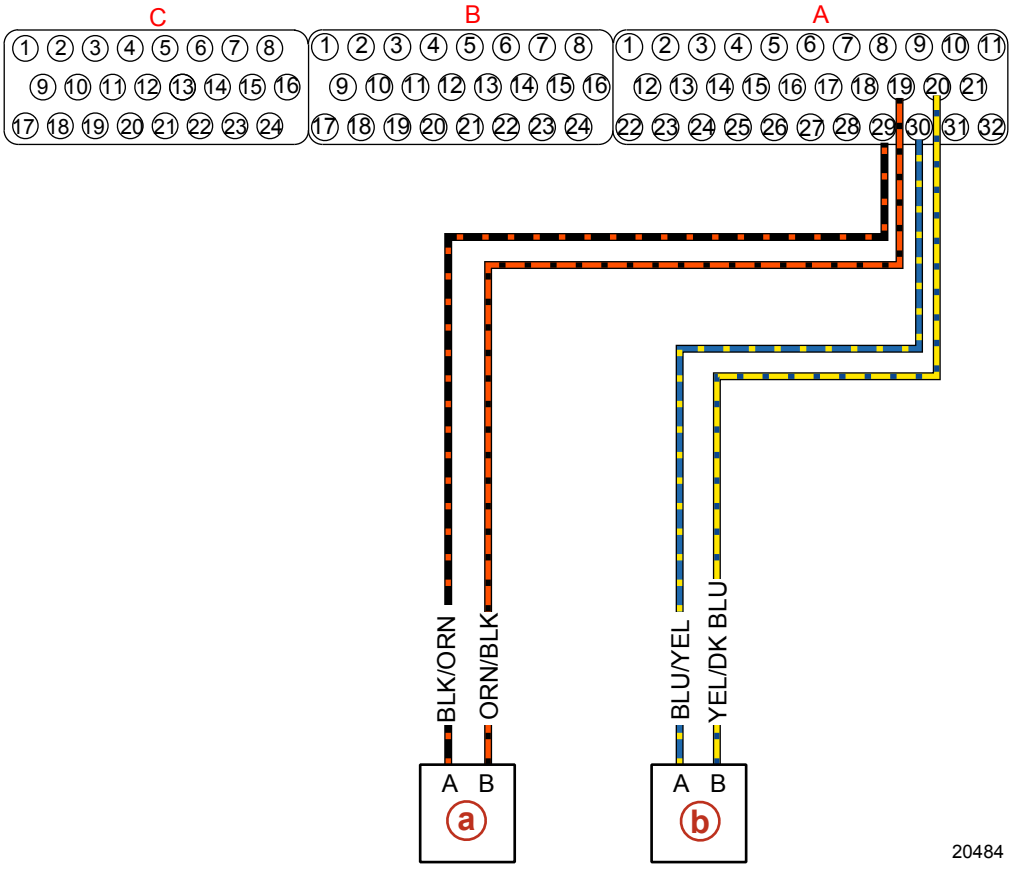


a - Manifold air temperature sensor (MAT) connector
b - 5 Volt transducer ground
c - Signal wire

The manifold air temperature sensor (MAT) is a thermistor that controls signal voltage to the PCM. It is located at the rear of the engine in the intake manifold air stream. When intake air is cold, the sensor resistance is high. As the air temperature rises, resistance lowers. At normal engine operating temperature, 71-82° C (160-180° F), the voltage will measure about 1.5 to 2.0 volts.

A malfunction in the MAT will set the fault of AIR TMP CKT Hi or AIR TMP CKT Lo.

Odd And Even Knock Sensor Circuits

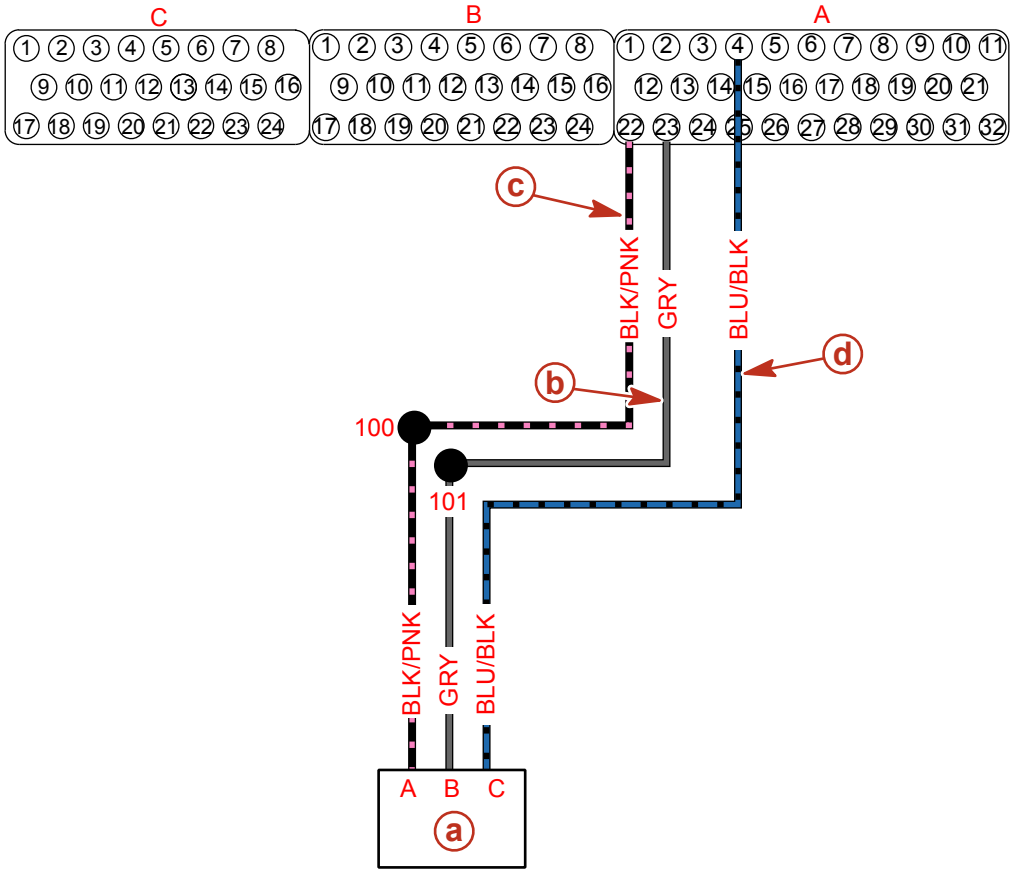


a - Odd knock sensor **b -** Even knock sensor

Knock sensors detect engine detonation or spark knock and send a voltage signal to the PCM. The knock sensors are located on the lower half of the engine on both the odd (port) and even (starboard) sides. As the sensor detects knock, the voltage output level increases and signals the PCM.

An unacceptable knock sensor reading will set a fault of Knock Sensor HI or Knock Sensor LO.

Oil Pressure Sensor Circuit

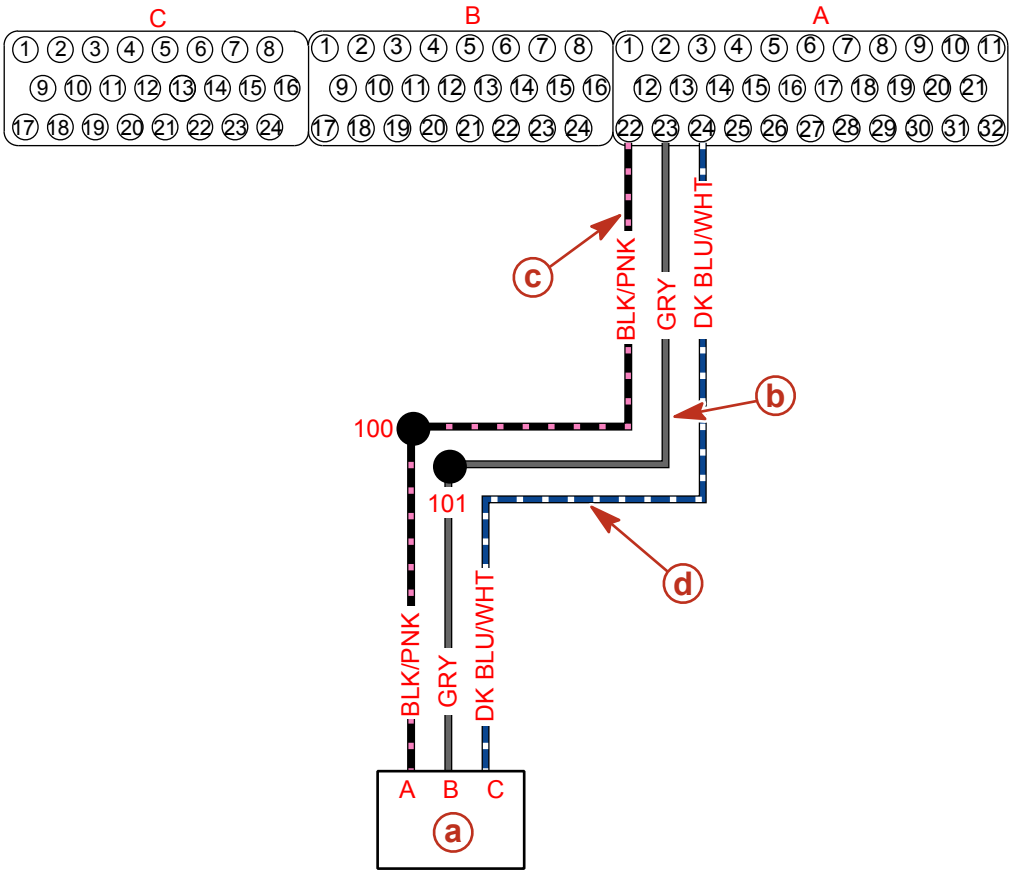


a - Oil Pressure Sensor
b - 5 Volt power
c - 5 Volt ground
d - Signal to the PCM

The oil pressure sensor measures oil pressure in the oil galleries. The sensor is located on the rear port side of the engine.

A malfunction of the oil pressure sensor will set the fault Oil PSI CKT Hi, Oil PSI CKT Lo or Oil PSI Lo.

Seawater Pump Circuit

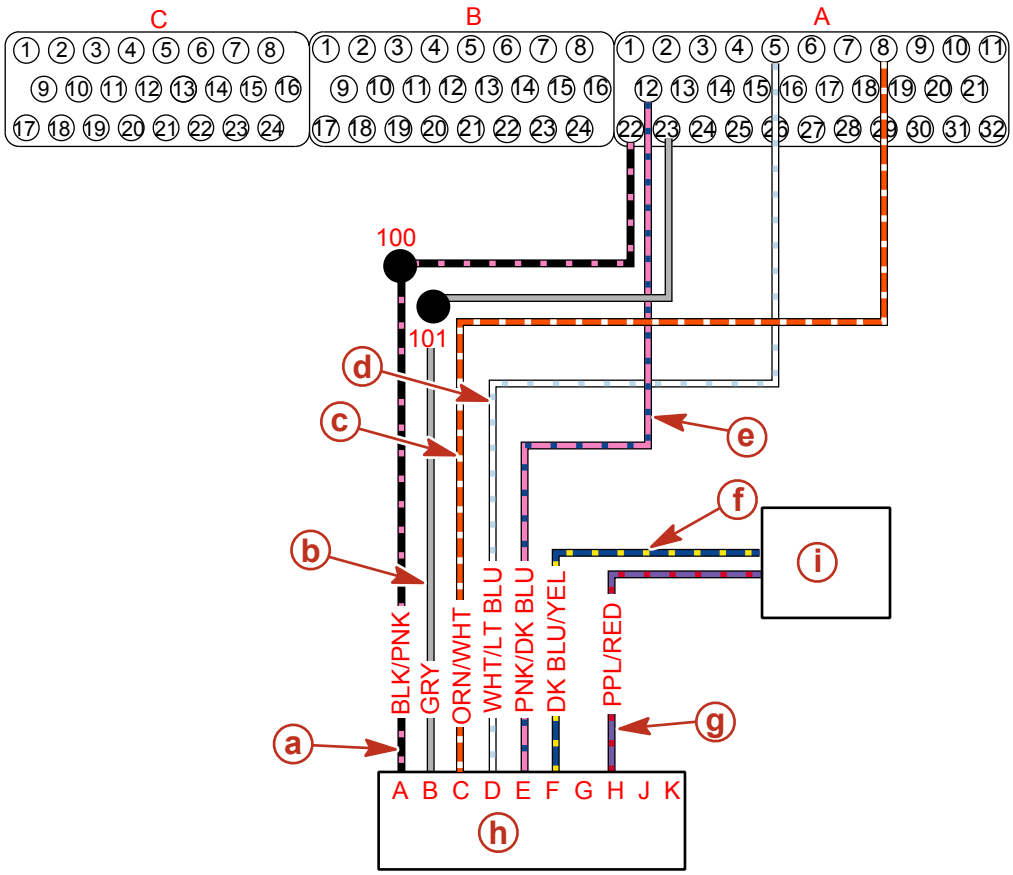


a - Seawater pump sensor connector
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The seawater pump sensor measures water inlet pressure or water block pressure. The integrated harness uses a 50 psi sensor. It is located at the power steering cooler (sterndrive) or transmission cooler (inboard). Normal diagnostic tool ranges are 7-34 kPa (1-5 psi) at idle and 207 kPa (30 psi) maximum at WOT.

A malfunction of the seawater pump sensor will set the fault of Seapump CKT Hi, Seapump CKT Lo or Seapump PSI Lo.

Smart Transom Circuit (Engine Harness)—Harness 84-865457A02

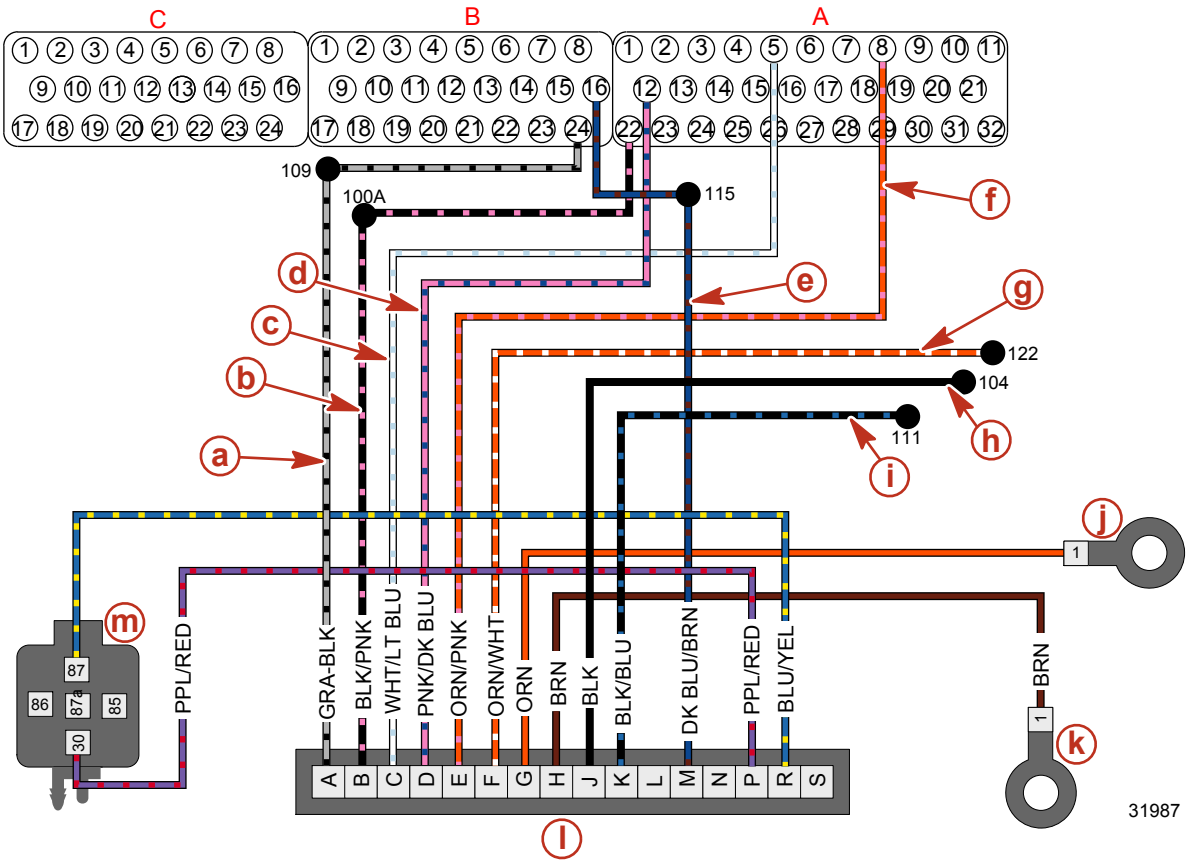


a - Transducer ground (–)
b - 5 Volt transducer power
c - Trim position signal
d - Pitot signal
e - Steering signal
f - Trim up relay signal
g - 12 Volt power from trim pump
h - 10 Pin transom connector
i - Trim up relay

The smart transom harness connection is located at the rear of the engine on the upper port side. It controls communication between the transom sensors and the PCM. Pin B supplies 5 V power to the trim position sensor, pitot and steering.

A malfunction in the smart transom circuit will set a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo.

Smart Transom Circuit (Engine Harness)—Harness 84-865457A05

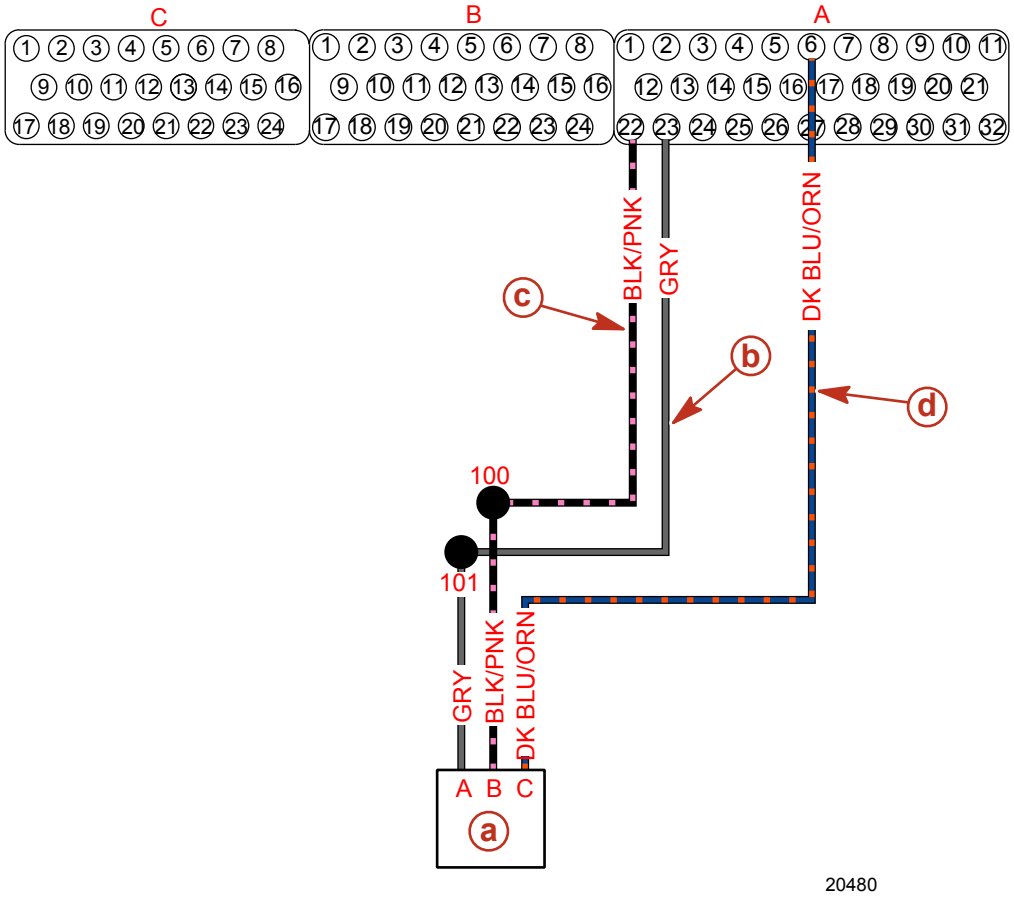


a - 5 Volt transducer power (SmartCraft sensors)
b - Transducer ground (–)
c - Pitot signal
d - Steering signal
e - Drive lube monitor (sterndrive) or transmission oil temperature (inboard) signal
f - Digital trim signal
g - To splice 122 (to 14 pin connector)
h - To splice 104 (battery ground [–])
i - To splice 111 (to starter relay)
j - MerCathode anode signal
k - MerCathode electrode signal
l - 16 Pin transom connector
m - Trim up relay

The smart transom harness connection is located at the rear of the engine on the upper port side. It controls communication between the transom sensors and the PCM. Pin B supplies 5 V power to the trim position sensor, pitot and steering.

A malfunction in the smart transom circuit will set a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo.

Throttle Position Sensor (TPS) Circuit

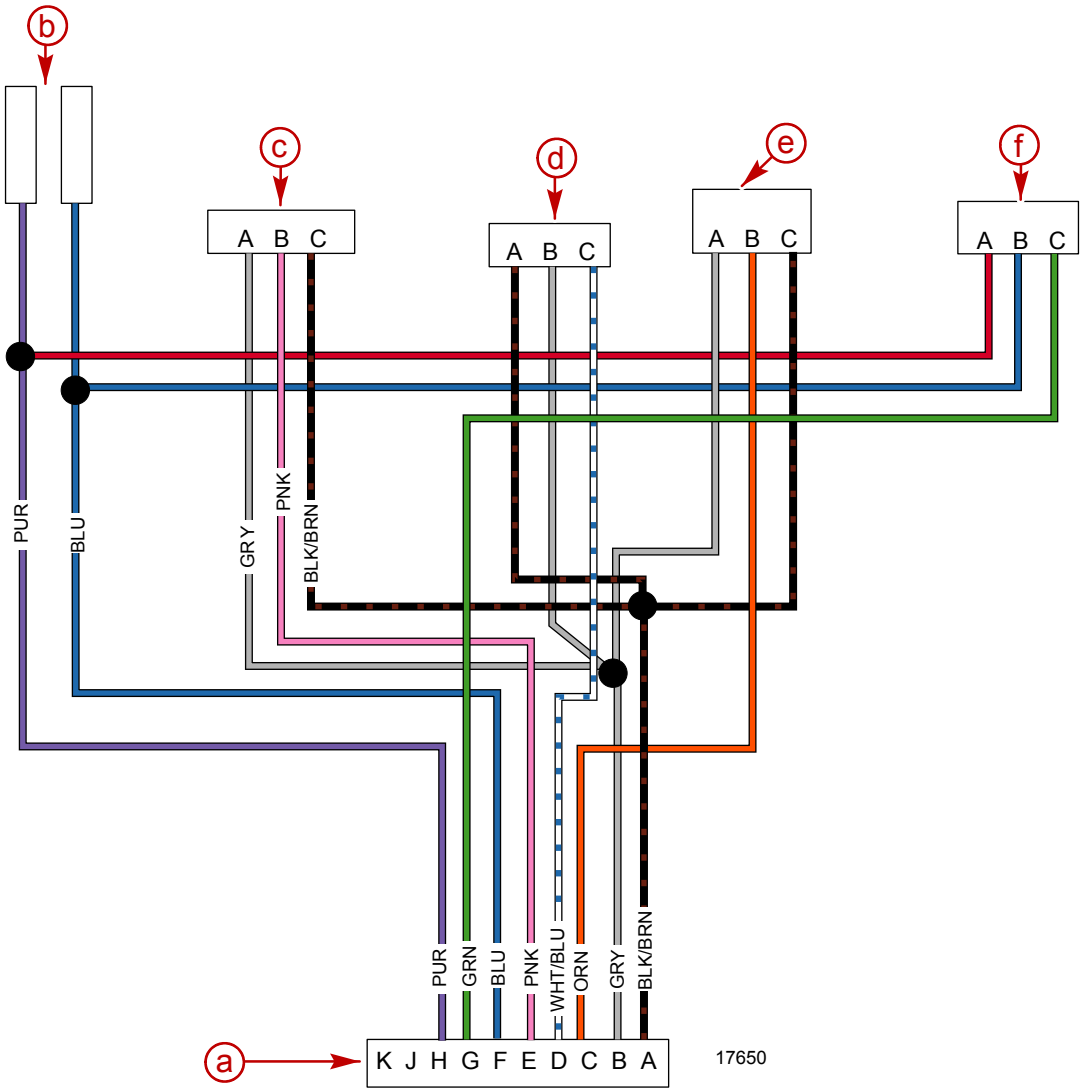


a - Throttle position sensor (TPS)
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The throttle position sensor (TPS) sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at WOT. If the TPS malfunctions, the ECM will reset to a default value.

A malfunction in the TPS circuit will set the fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo.

Transom Circuit (Transom Harness)



a - Transom harness to engine harness connector

b - Trim Limit connectors on mechanical throttle and shift

c - Steering sensor connector

d - Speedometer sensor

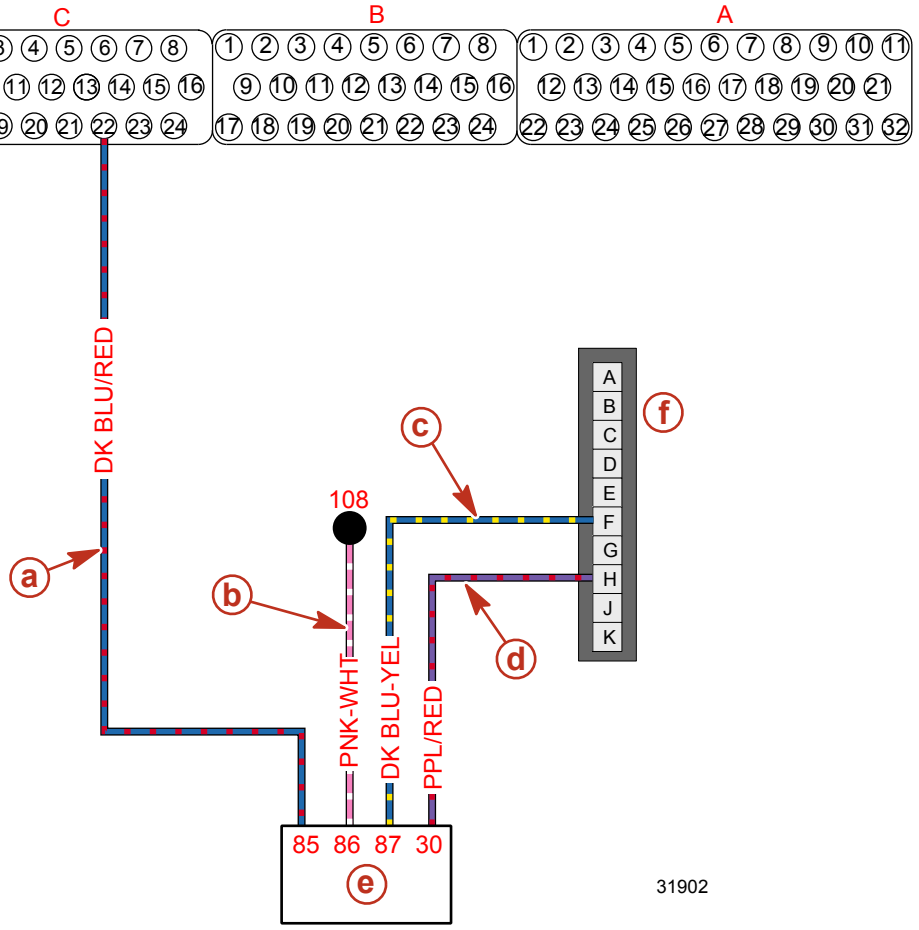
e - Trim sensor

f - Trim limit connector for electronic throttle and shift

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the engine harness and the inner transom. Do not connect both of the trim limit connectors, "b" and "f", simultaneously as this will cause a failure in the trim limit circuit.

A malfunction in the transom harness will set the fault of Trim CKT HI, Trim CKT LO, Steering Angle Input HI or Steering Angle Input LO.

Trim Up Relay Circuit—84-865457A02

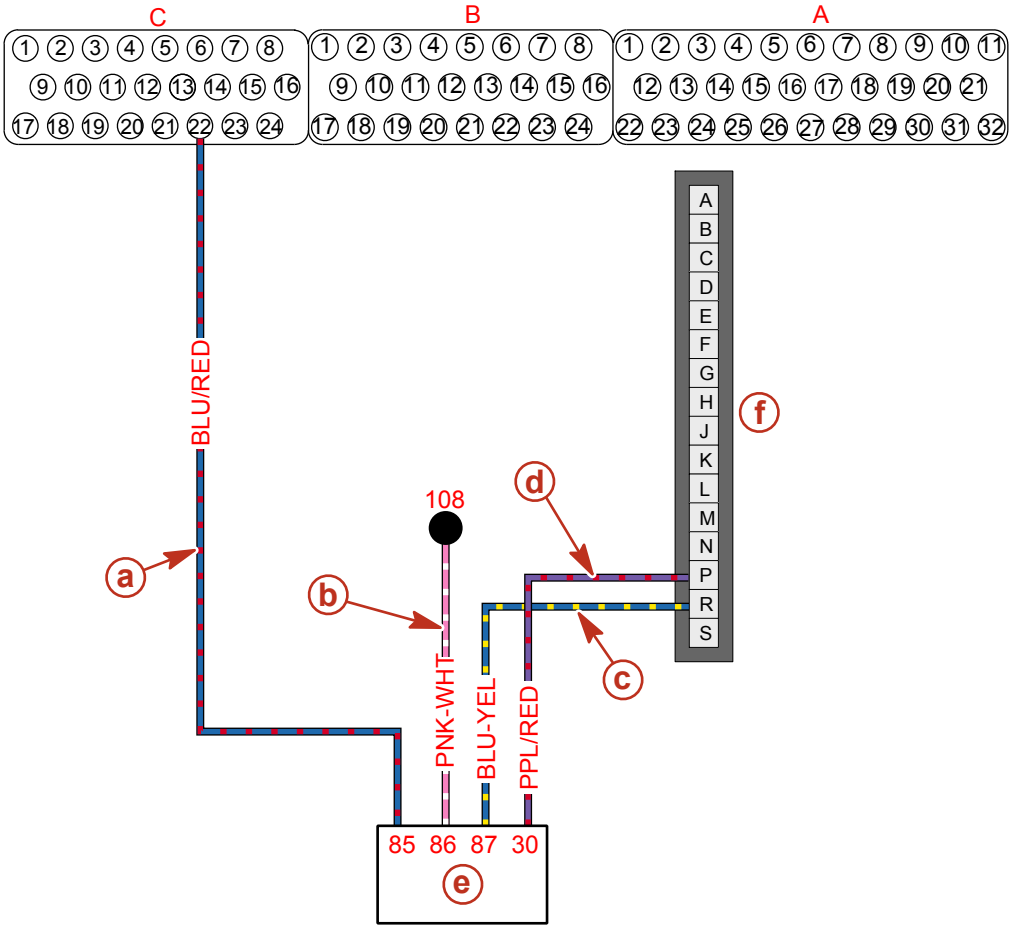


a - Reference control from PCM
b - 12 Volt power to trim up relay
c - Trim up signal
d - 12 Volt power from trim pump
e - Trim up relay
f - 10 Pin transom harness connector

The trim up relay circuit receives power through splice 105 and signals through the Smart Transom to trim the sterndrive unit. It is located on the upper port side of the engine.

A malfunction in the trim up relay circuit will set the fault Trim CKT Hi or Trim CKT Lo.

Trim Up Relay Circuit—84-865457A05



a - Reference
b - 12 Volt power to trim up relay
c - Trim up signal
d - 12 Volt power from trim pump
e - Trim up relay
f - 16 Pin transom connector

The trim up relay circuit receives power through aplice 105 and signals through the Smart Transom to trim the sterndrive unit. It is located on the upper port side of the engine.

A malfunction in the trim up relay circuit will set the fault Trim CKT Hi or Trim CKT Lo.

Notes:

Diagrams

Section 3C - Diagrams—14 Pin

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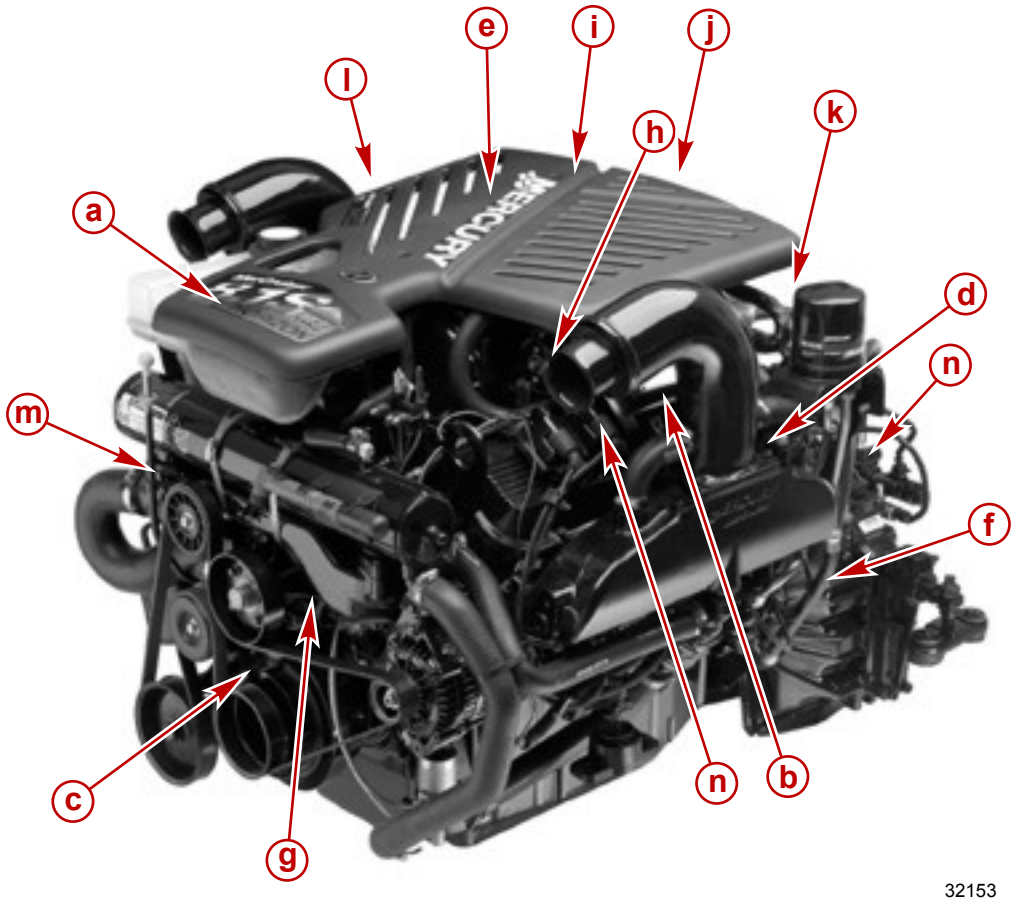
3C

Sensor Locations—14 Pin

Sensors related to the PCM 555 wiring covered in this section are located as shown.



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- **a -** Throttle position sensor (TPS)
- **b -** Electronic control module (PCM)
- **c -** Crankshaft position sensor (CPS)
- **d -** Port exhaust manifold coolant temperature sensor (EMCT)
- **e -** Data link connector (DLC)—under engine cover
- **f -** Oil pressure sensor
- **g -** Camshaft position sensor (CMP)
- **h -** Manifold absolute pressure sensor (MAP)
- **i -** Manifold air temperature sensor (MAT)
- **j -** Idle air control valve (IAC)
- **k -** Seapump pressure sensor—on fluid cooler
- **l -** Starboard exhaust manifold coolant temperature sensor (EMCT)
- **m -** Engine coolant temperature sensor (ECT)
- **n -** Transmission over-temp sensor

Engine Harness

Wiring Color Legend

Wire Label	Wire Color
BLU	Blue
DK BLU	Dark Blue
LT BLU	Light Blue
BLK	Black

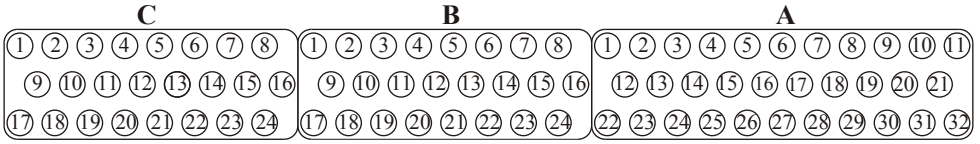
Wire Label	Wire Color
GRA or GRY	Gray
GRN	Green
DK GRN	Dark Green
ORN	Orange
PPL or PUR	Purple
RED	Red
TAN	Tan
WHT	White
YEL	Yellow

Wire Splice Description—14 Pin

Splice Number	Description
100	5 volt transducer ground
101	5 volt transducer power for sensors
102	Wake line, fused 20 amp, 12 volt power (key on only)
103 and 103A	Clean (continuous) power / helm
104	Battery ground (-), 12 volt
105	Main Power Relay (key on only), 12 volt
106	EST return
107	Power to PCM, 12 volt fused
108	Switched, 12 volt fused
109	5 volt Power 2 (SmartCraft)
110	50 A protected, unswitched (DTS)
114	Tachometer lead (DTS)

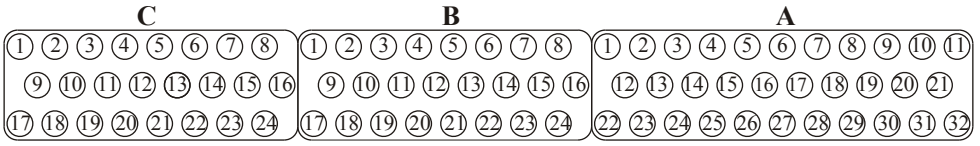
PCM 555 Pin-out—14 Pin, 496/8.1

Use this table as a quick reference guide to the pins of the PCM to verify broken pins, what the pins control, and to aid in checking circuit continuity.



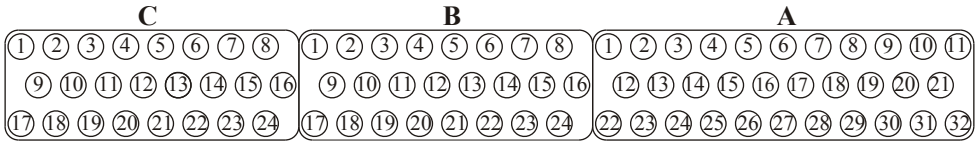
Connector A—14 Pin, 496/8.1

Mercury Part Number		84-865457A06	84-865458A01	84-865653A03	84-865653A04
Pin		14 Pin	DTS (1st model—yellow CAN cable)	DTS (14 Pin/10 Pin)	DTS (14 Pin)
A1	Key-on Power (Wakeup)	PPL	PPL	PPL	PPL
A2	Shift Position (From ESC)	Empty	LT BLU/GRN	LT BLU/GRN	LT BLU/GRN
A3	MAP Signal	LT GRN	LT GRN	LT GRN	LT GRN
A4	Oil Pressure Signal	BLU/BLK	DK BLU/BLK	BLU/BLK	BLU/BLK
A5	Pitot Signal	WHT/LT BLU	WHT/LT BLU	WHT/LT BLU	WHT/LT BLU
A6	Throttle Position Sensor 1 Signal	DK BLU/ORN	DK BLU/ORN	DK BLU/ORN	DK BLU/ORN
A7	Throttle Position Sensor 2 Signal	Empty	BLK/BLU	BLK/BLU	BLK/BLU
A8	Digital Trim Signal	ORN/LT BLU	ORN/WHT	ORN/PNK	ORN/LT BLU
A9	Starboard Tab Position Signal	Empty	BLU/RED	Empty	Empty
A10	Port Tab Position Signal	Empty	GRY/RED	Empty	Empty
A11	CAN Line 1 Pos (+)	WHT	WHT	WHT	WHT
A12	Steering Position (Smart Transom)	PNK/DK BLU	PNK/DK BLU	PNK/DK BLU	PNK/DK BLU
A13	Seawater Temperature Signal	WHT/YEL	WHT/YEL	WHT/YEL	WHT/YEL
A14	MAT Signal	TAN/YEL	TAN/YEL	TAN/YEL	TAN/YEL
A15	ECT Signal	YEL	YEL	YEL	YEL
A16	Port EMCT Signal	BRN/WHT	BRN/WHT	BRN/WHT	BRN/WHT
A17	Starboard EMCT Signal	BRN/BLK	BRN/BLK	BRN/BLK	BRN/BLK
A18	Scan (–)	WHT/PPL	WHT/PPL	WHT/PPL	WHT/PPL
A19	Port Knock Sensor 1 (–)	ORN/BLK	ORN/BLK	ORN/BLK	ORN/BLK
A20	Starboard Knock Sensor 2 (–)	YEL/WHT	YEL/BLU	YEL/BLU	YEL/WHT
A21	CAN 1 Line Neg (–)	LT BLU	LT BLU	LT BLU	LT BLU
A22	Sender Ground	BLK/PNK	BLK/PNK	BLK/PNK	BLK/PNK
A23	Sender Power	GRY	GRY	GRY	GRY
A24	Seapump Signal	DK BLU/WHT	DK BLU/WHT	DK BLU/WHT	DK BLU/WHT
A25	Fuel Level 2 Signal	LT BLU/BLK	LT BLU/BLK	LT BLU/BLK	LT BLU/BLK
A26	Fuel Level 1 Signal	PNK/BLK	PNK/BLK	PNK/BLK	PNK/BLK
A27	Empty	Empty	Empty	Empty	Empty
A28	Scan (+)	WHT/BLK	WHT/BLK	WHT/BLK	WHT/BLK
A29	Port Knock Sensor 1 (+)	BLK/ORN	BLK/ORN	BLK/ORN	BLK/ORN
A30	Starboard Knock Sensor 2 (+)	BLU/YEL	DK BLU/YEL	BLU/YEL	BLU/YEL
A31	CAN 2 Pos (+)	Empty	GRN/ORN	GRN/ORN	GRN/ORN
A32	CAN 2 Neg (–)	Empty	GRN/RED	GRN/RED	GRN/RED



Connector B—14 Pin, 496/8.1

Mercury Part Number		84-865457A06	84-865458A01	84-865653A03	84-865653A04
Pin		14 Pin	DTS (1st model—yellow CAN cable)	DTS (14 Pin/10 Pin)	DTS (14 Pin)
B1	EST Return	BRN/YEL	BRN	BRN/YEL	BRN/YEL
B2	EST Coil 1 Trigger	GRN/BRN	WHT/BLK	WHT/BLK	GRN/BRN
B3	Paddle Wheel Signal	YEL/GRY	YEL/GRY	YEL/GRY	YEL/GRY
B4	Main Power Relay Control	PPL/DK GRN	PPL/DK GRN	PPL/DK GRN	PPL/DK GRN
B5	Empty	Empty	Empty	Empty	Empty
B6	CAM Sensor Signal	PPL/RED	PPL/WHT	PPL/WHT	PPL/RED
B7	IAC Valve Control	BLK/GRN	Empty	Empty	Empty
B8	Assist Solenoid	Empty	YEL/BLK	YEL/BLK	YEL/BLK
B9	EST Coil 5 Trigger	WHT/GRY	WHT/LT BLU	WHT/LT BLU	WHT/GRY
B10	EST Coil 3 Trigger	WHT/GRN	WHT/PPL	WHT/PPL	WHT/GRN
B11	Fuel Pump Relay Control	GRN/BLK	DK GRN	GRN	GRN/BLK
B12	Tachometer	GRY/WHT	GRY/WHT	GRY/WHT	GRY/WHT
B13	Empty	Empty	Empty	Empty	Empty
B14	Crankshaft Position Sensor Signal	TAN/BLK	TAN/BLK	TAN/BLK	TAN/BLK
B15	Gear Position Switch Signal	YEL/PNK	YEL/DK GRN	YEL/GRN	YEL/PNK
B16	Drive Lube Monitor Or Trans Oil Temp Switch	DK BLU/BRN	DK BLU/BRN	DK BLU/BRN	DK BLU/BRN
B17	MPR Output (to PCM)	PNK/LT GRN	PNK/LT GRN	PNK/LT GRN	PNK/LT GRN
B18	MPR Output (to PCM)	PNK/LT GRN	PNK/LT GRN	PNK/LT GRN	PNK/LT GRN
B19	Empty	Empty	Empty	Empty	Empty
B20	Fuel Injector 4	LT GRN/ORN	LT GRN/BLK	LT GRN/BLK	LT GRN/ORN
B21	Warning Horn	BRN/DK BLU	BRN/DK BLU	BRN/DK BLU	Empty
B22	Fuel Injector 3	LT GRN/LT BLU	LT GRN/LT BLU	LT GRN/LT BLU	LT GRN/LT BLU
B23	E-Stop (thru CAN)	GRN/YEL	DK GRN/YEL	GRN/YEL	GRN/YEL
B24	Power 2 (Smartcraft Sensors)	GRY/BLK	GRY/BLK	GRY/BLK	GRY/BLK

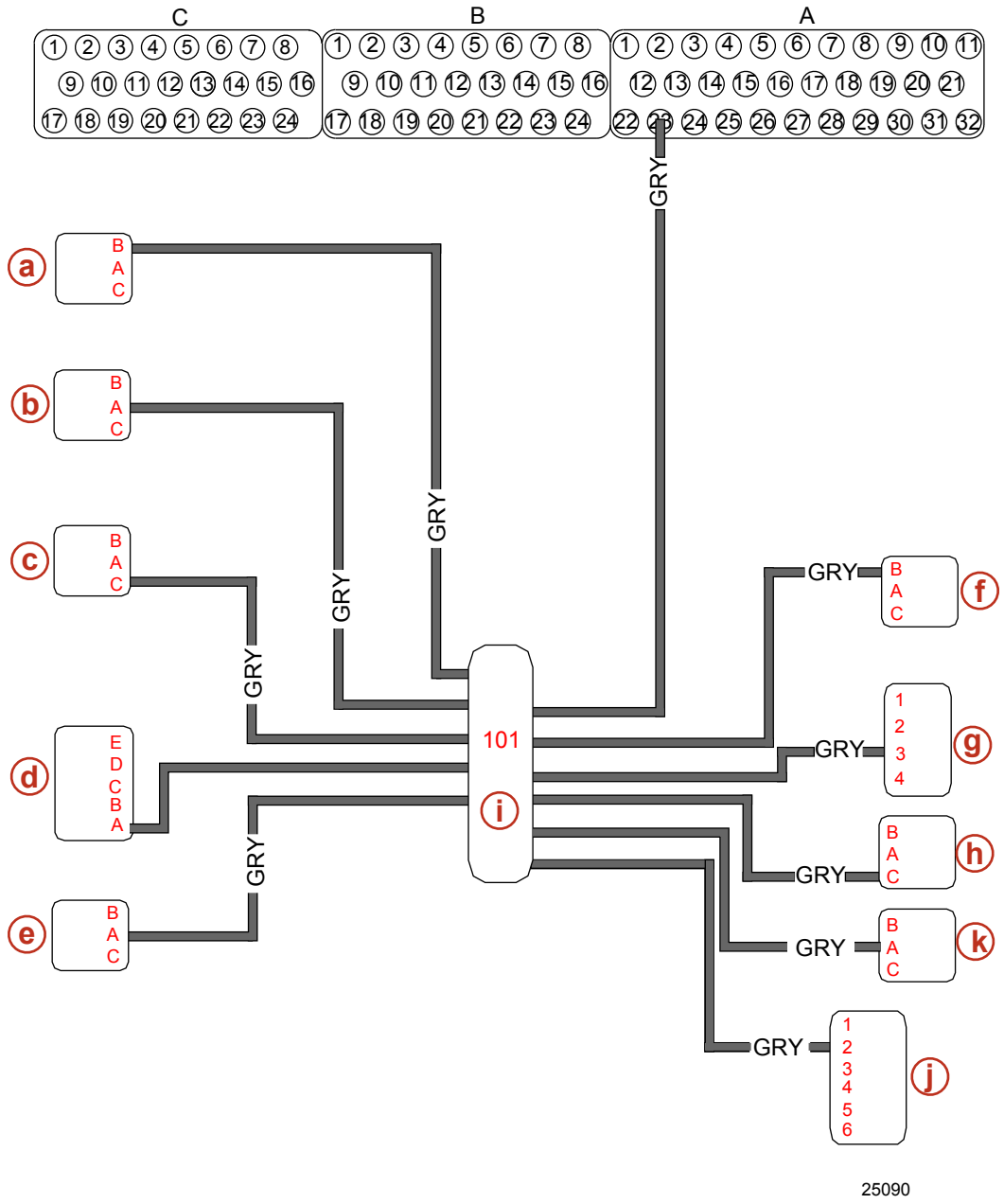


Connector C—14 Pin, 496/8.1

Mercury Part Number		84-865457A06	84-865458A01	84-865653A03	84-865653A04
Pin		14 Pin	DTS (1st model—yellow CAN cable)	DTS (14 Pin/10 Pin)	DTS (14 Pin)
C1	Port Tab Up Solenoid	Empty	BLK/BLU	Empty	Empty
C2	ETC Pin 3 (Driver)	Empty	PPL/WHT	PPL/WHT	PPL/WHT
C3	Fuel Injector 8	LT GRN/DK BLU	LT GRN/DK BLU	LT GRN/DK BLU	LT GRN/DK BLU
C4	ETC Pin 5 (Driver)	Empty	LT BLU/WHT	LT BLU/WHT	LT BLU/WHT
C5	Fuel Injector 7	LT GRN/BLK	LT GRN/BLK	ORN/GRY	LT GRN/BLK
C6	Fuel Injector 1	GRN/BLU	LT GRN/ORN	LT GRN/ORN	GRN/BLU
C7	EST Coil 4 Trigger	WHT/RED	WHT/RED	WHT/RED	WHT/RED
C8	EST Coil 2 Trigger	WHT/BRN	WHT/DK GRN	WHT/GRN	WHT/BRN
C9	Starboard Tab Up Solenoid	Empty	BLK/LT GRN	Empty	Empty
C10	Starboard Tab Down	Empty	GRY/DK BLU	Empty	Empty
C11	Fuel Injector 2	LT GRN/PPL	LT GRN/PPL	LT GRN/PPL	LT GRN/PPL
C12	EST Coil 6 Trigger	WHT/LT GRN	WHT/LT GRN	WHT/BRN	WHT/LT GRN
C13	EST Coil 7 Trigger	WHT/DK BLU	WHT/DK BLU	WHT/DK BLU	WHT/DK BLU
C14	EST Coil 8 Trigger	WHT/ORN	WHT/PPL	WHT/PPL	WHT/ORN
C15	Ground	BLK	BLK	BLK	BLK
C16	Ground	BLK	BLK	BLK	BLK
C17	ESC Pin D (Driver)	Empty	YEL/RED	YEL/RED	RED/GRN
C18	ESC Pin E (Driver)	Empty	YEL/GRN	YEL/GRN	YEL/GRN
C19	Port Tab Down Solenoid	Empty	GRY/DK GRN	Empty	Empty
C20	Trim Down Relay Control	Empty	DK GRN/YEL	GRN/YEL	GRN/PPL
C21	Fuel Injector 6	LT GRN/RED	LT GRN/RED	LT GRN/RED	LT GRN/RED
C22	Trim Up Relay	DK BLU/PNK	BLU/RED	BLU/RED	DK BLU/PNK
C23	Fuel Injector 5	LT GRN/WHT	LT GRN/WHT	LT GRN/WHT	LT GRN/WHT
C24	Ground	BLK	BLK	BLK	BLK

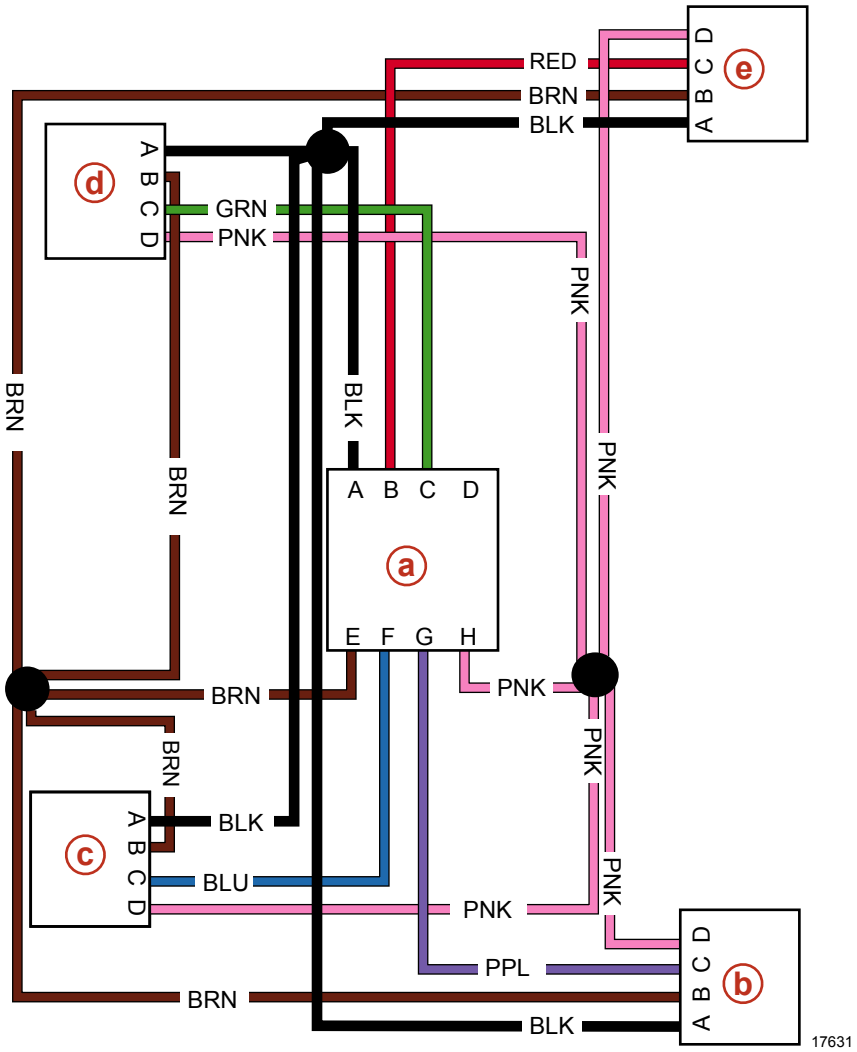
Wiring Diagrams

5 Volt Sensor Circuit—PCM Power 1



a - Seawater pump pressure sensor
b - TPS (non-DTS)
c - MAP (496/8.1L)
d - Electronic shift control (DTS)
e - CPS
f - Oil pressure sensor
g - TMAP (5.0, 5.7,6.2)
h - CMP (5.0, 5.7, and 6.2)
i - Splice 101
j - Electronic throttle control (DTS)
k - CMP (496/8.1L)

Coil Harness Circuit—496/8.1

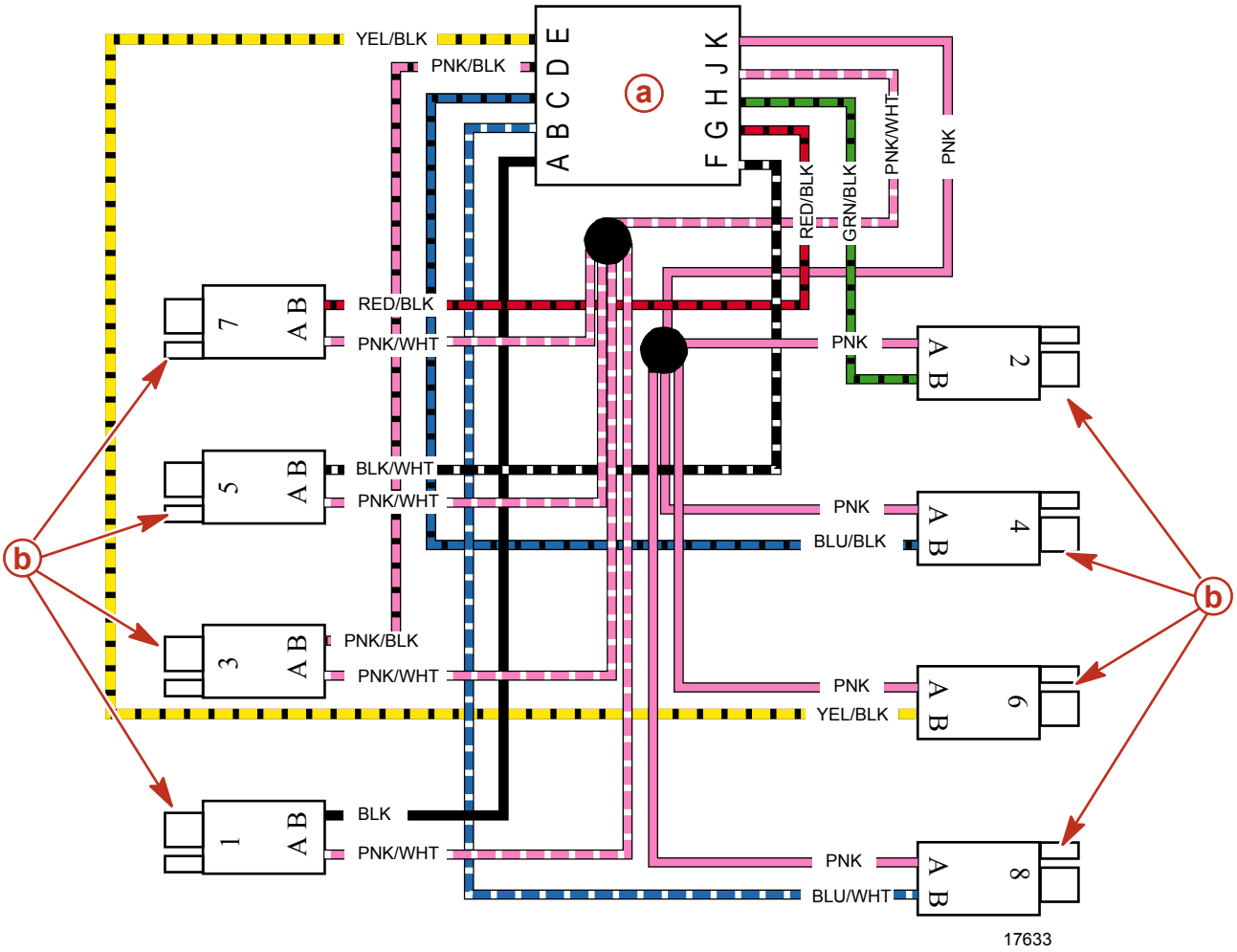


a - Coil harness to engine harness connector (two per engine)
b - 1 (odd) or 8 (even) coil connector
c - 3 (odd) or 6 (even) coil connector
d - 5 (odd) or 4 (even) coil connector
e - 7 (odd) or 2 (even) coil connector

There are 2 coil harnesses on the engine, one for each side of the engine. The harnesses are wired identically. The signal wire color for coils 1 and 8 is PPL, coils 3 and 6 is BLU, 5 and 4 wire is GRN, and 7 and 2 is RED. The PNK wire is 12 volt power, the BRN wire is EST return and the BLK wire is ground. If a possible problem is suspected in the ignition system, check for faults once with key ON and once with engine running. An EST Open will only register a fault in a key ON only state and an EST Short will only register with the engine operating.

A malfunction in the coil harness will set the fault of EST 1-8 Open or EST 1-8 Short.

Fuel Injector Harness—496/8.1



a - Injector harness to engine harness connector

b - Individual injector connectors

The fuel injectors receive fused 12 volt power from Splice 108 (Pins J and K) on the injector harness. The PCM signals the injector to inject by pulling the 12 volts to ground and completing the circuit.

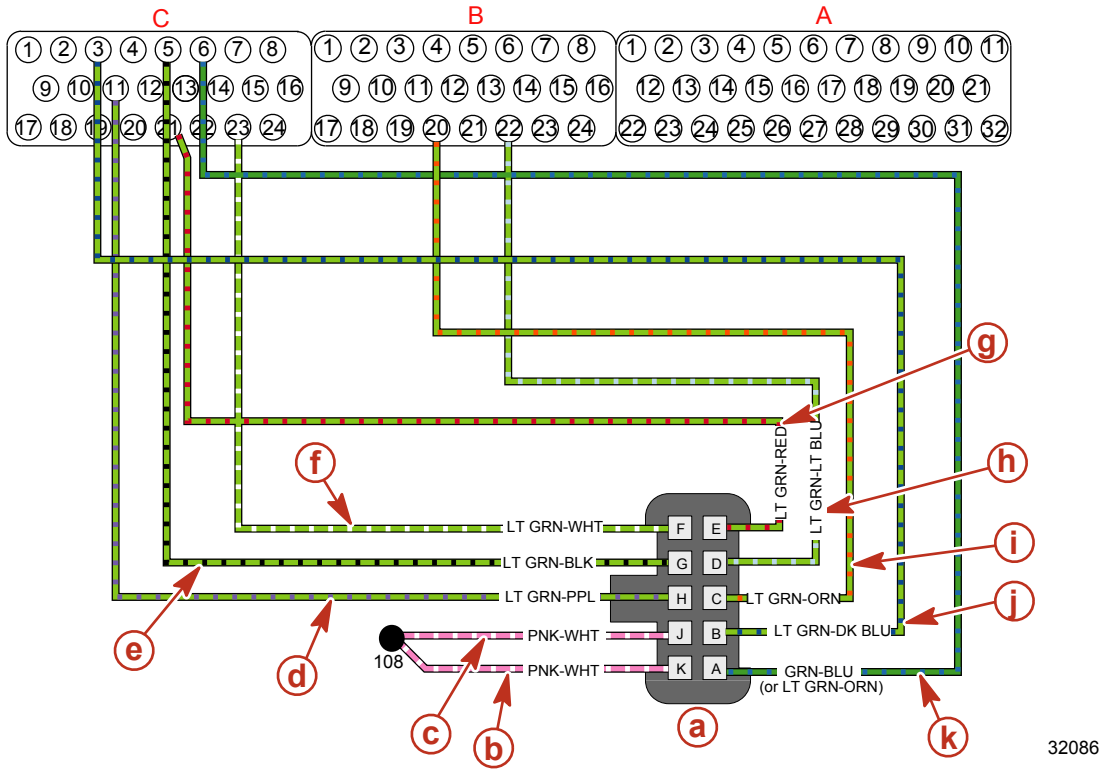
A malfunction in the fuel injector harness will set the fault of FINJ 1-8 Open or FINJ 1-8 Short.

When the fuel injector driver wire is shorted to ground, the scan tool will read Open Sensor, this means that the fuel injector is full Open.

When the fuel injector is shorted, the scan tool will read Short Injector.

Fuel Injector Number	Wire Colors on Fuel Injector Harness	PCM Pinout
1	BLK	C-6
2	GRN/BLK	C-11
3	PNK/BLK	B-22
4	BLU/BLK	B-20
5	BLK/WHT	C-23
6	YEL/BLK	C-21
7	RED/BLK	C-5
8	BLU/WHT	C-3

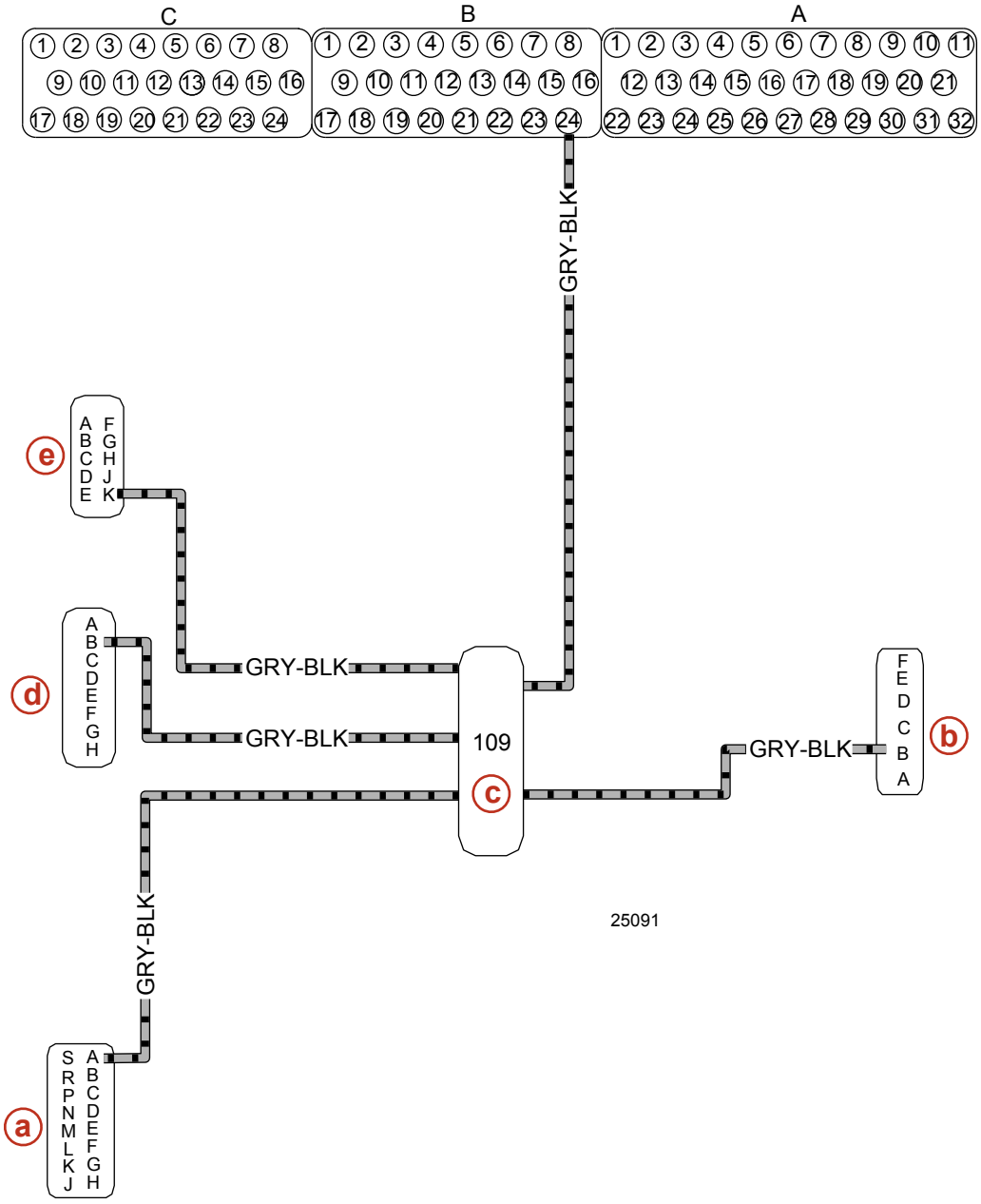
Fuel Injector Circuit (Engine Harness)



a - Engine harness to fuel injector harness connector
b - 12 Volt fused power to injectors (splice 108)
c - 12 Volt fused power to injectors (splice 108)
d - Injector 2
e - Injector 7
f - Injector 5
g - Injector 6
h - Injector 3
i - Injector 4
j - Injector 8
k - Injector 1

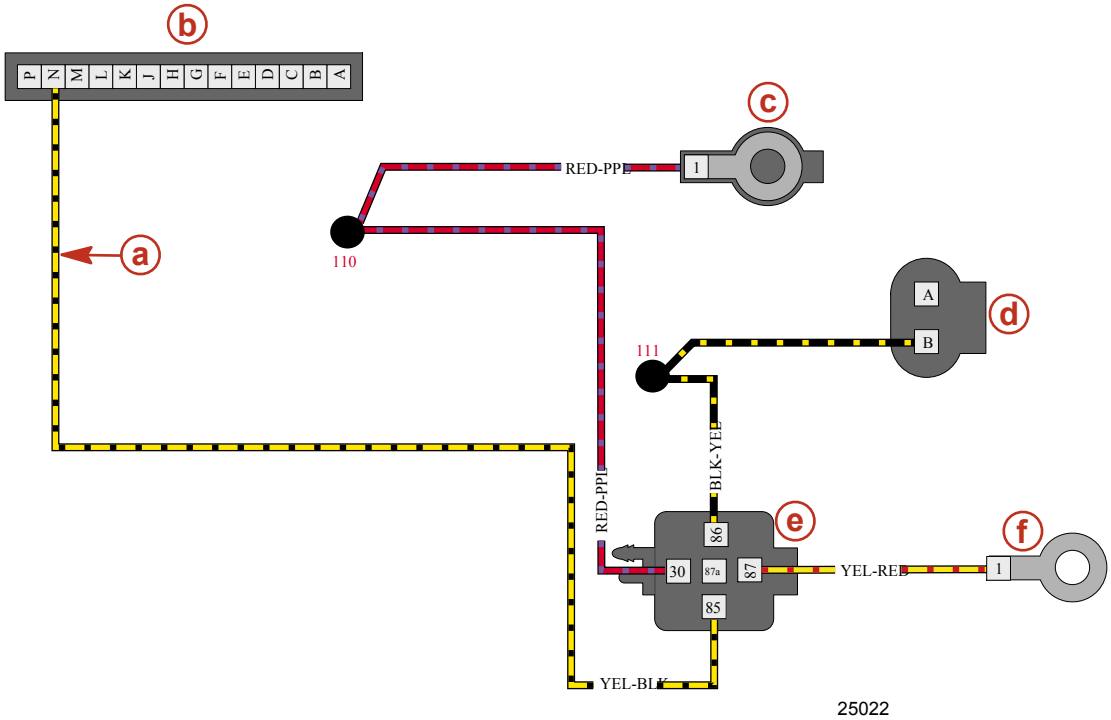
The fuel injectors receive fused 12 volt power on pins J and K of the engine harness connector from the splice 108. The PCM signals the injectors to activate by pulling the 12 volt to ground and completing the circuit through the engine harness and injector harness.

Power 2 Circuit



a - Smart transom (16 pin)—865653A03 and 865653A04
b - Paddle wheel
c - Splice 109
d - Smart transom (10 pin)—865458A01
e - Tabs—865458A01

Start Relay Circuit—Mechanical

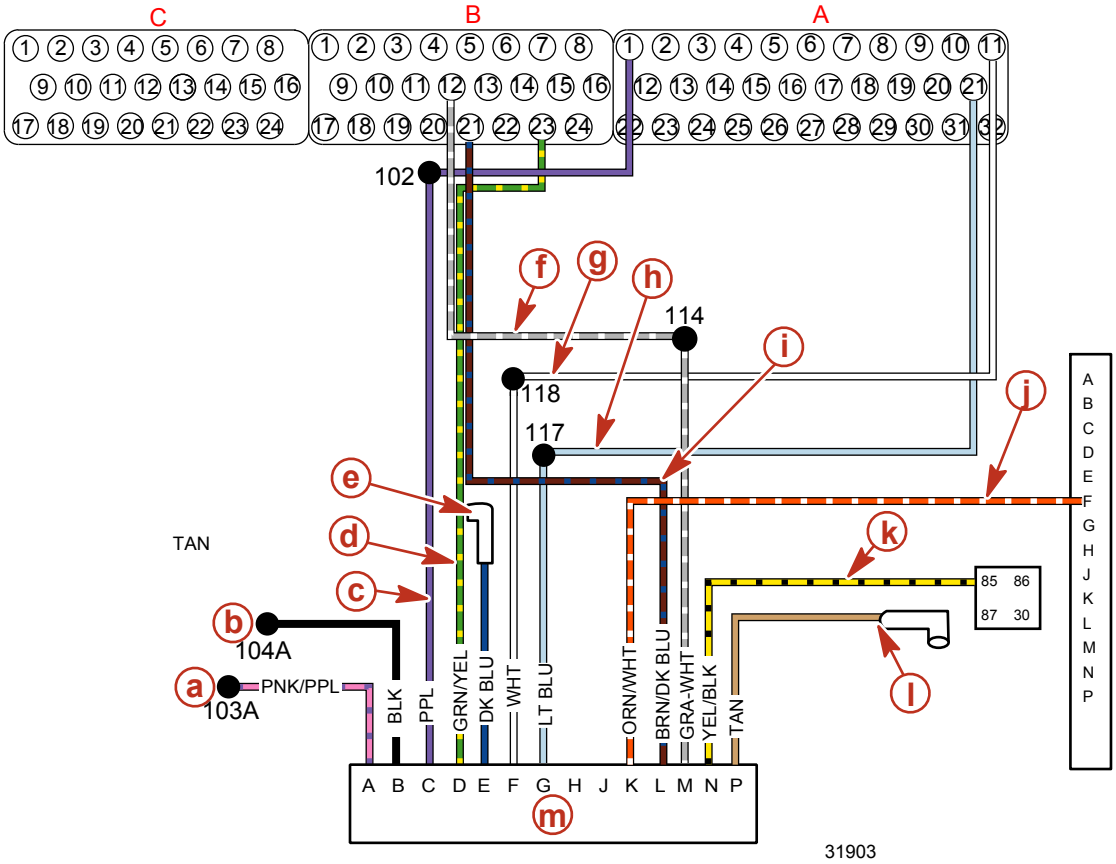


a - Power from key switch through 14 pin connector
b - 14 Pin connector
c - Circuit breaker, 50A
d - Gear position
e - Starter relay
f - Starter "S" stud

Single Circuit Diagrams

This section outlines the circuitry of the wiring harness and sensors as individual systems. This allows for a quick reference point when trying to detect a faulty connection. However, the complete system wiring diagram should be referenced if multiple electrical faults are occurring.

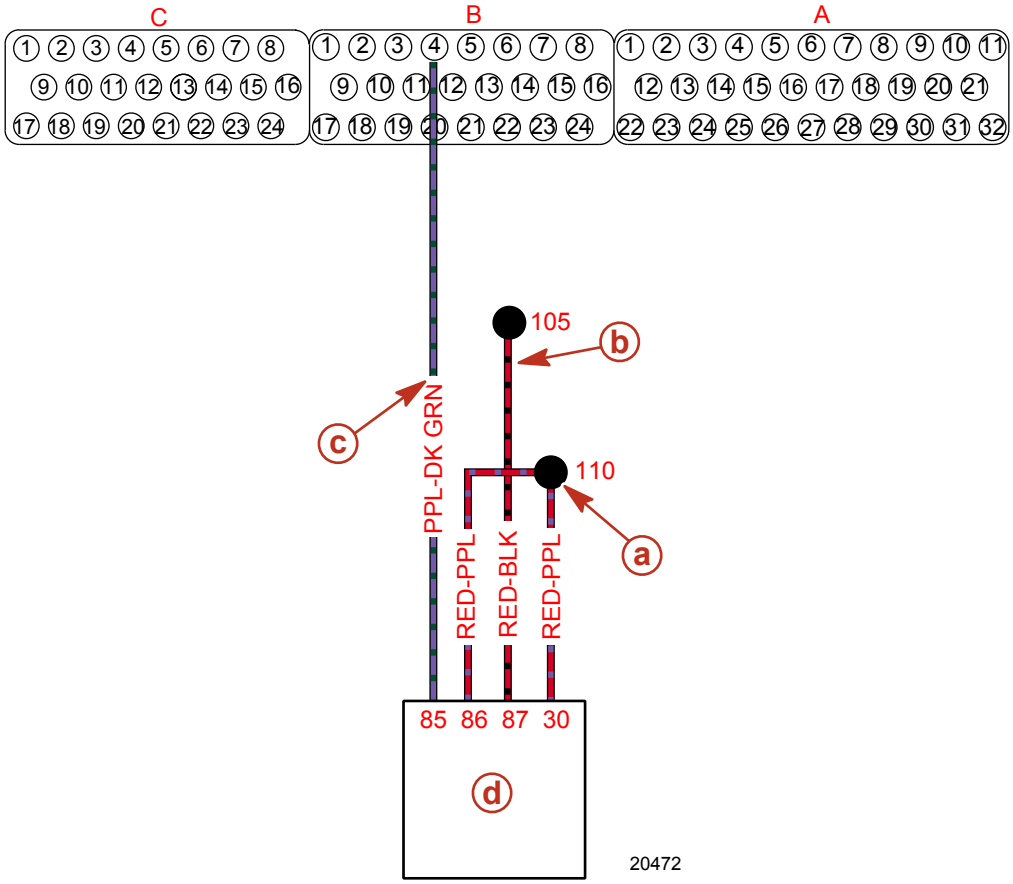
14 Pin Harness Circuit—84-865457A06



a - Power to helm
b - Ground (–)
c - Key on power (wake up)
d - E-stop
e - Analog oil pressure
f - Tachometer signal
g - CAN 1 +
h - CAN 1 –
i - Audio warning horn
j - Analog trim
k - Crank request
l - Analog coolant
m - 14 Pin connector

A malfunction of the 14 pin harness connection will not set a fault.

Main Power Relay Circuit—Serial Numbers OW000000 and Above

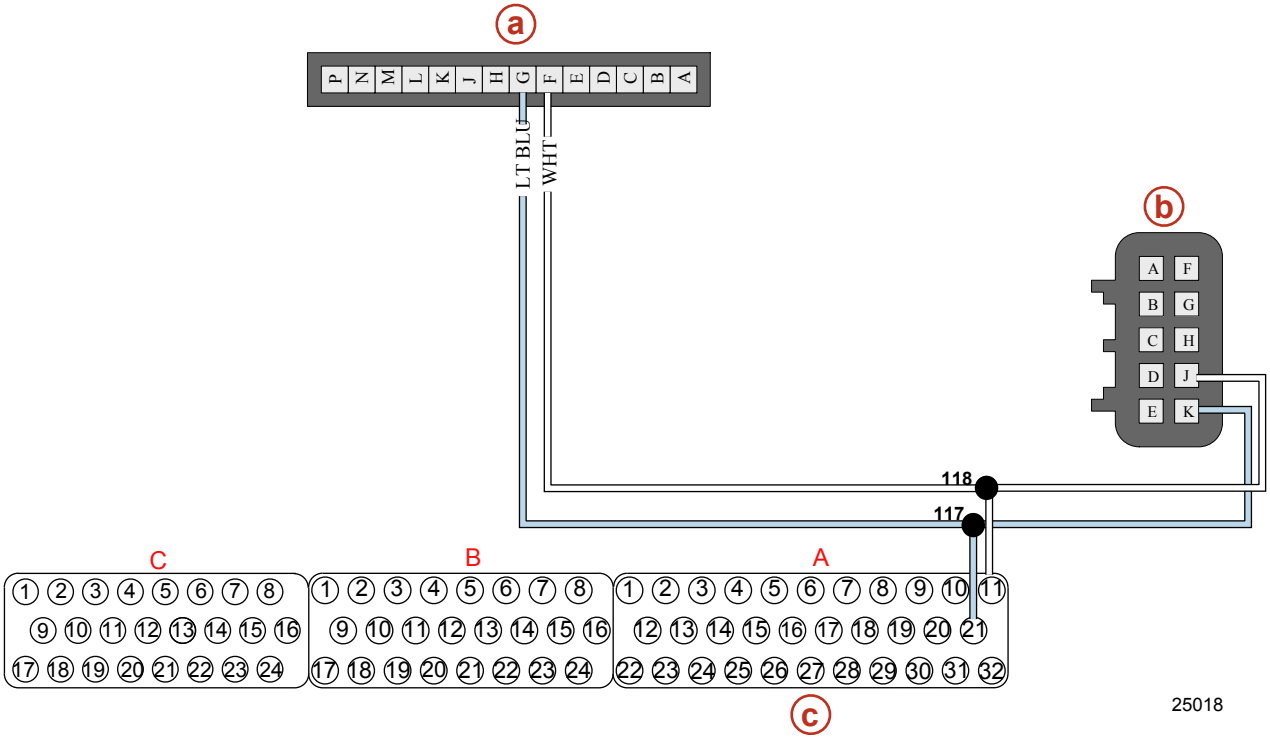


a - 50 A protected battery power
b - Output power to splice 105
c - Signal from PCM
d - MPR

When the key switch is in the on position the main power relay (MPR) is activated and sends 12 volt power to splice 105, which powers the IAC, fuel injectors, and part of the PCM. The MPR is located on the top of the engine near the PCM. Listen for a click on initial key on and check continuity to the MPR if a problem is suspected.

A malfunction of the MPR could result in the fault MPR Output or MPR Backfeed.

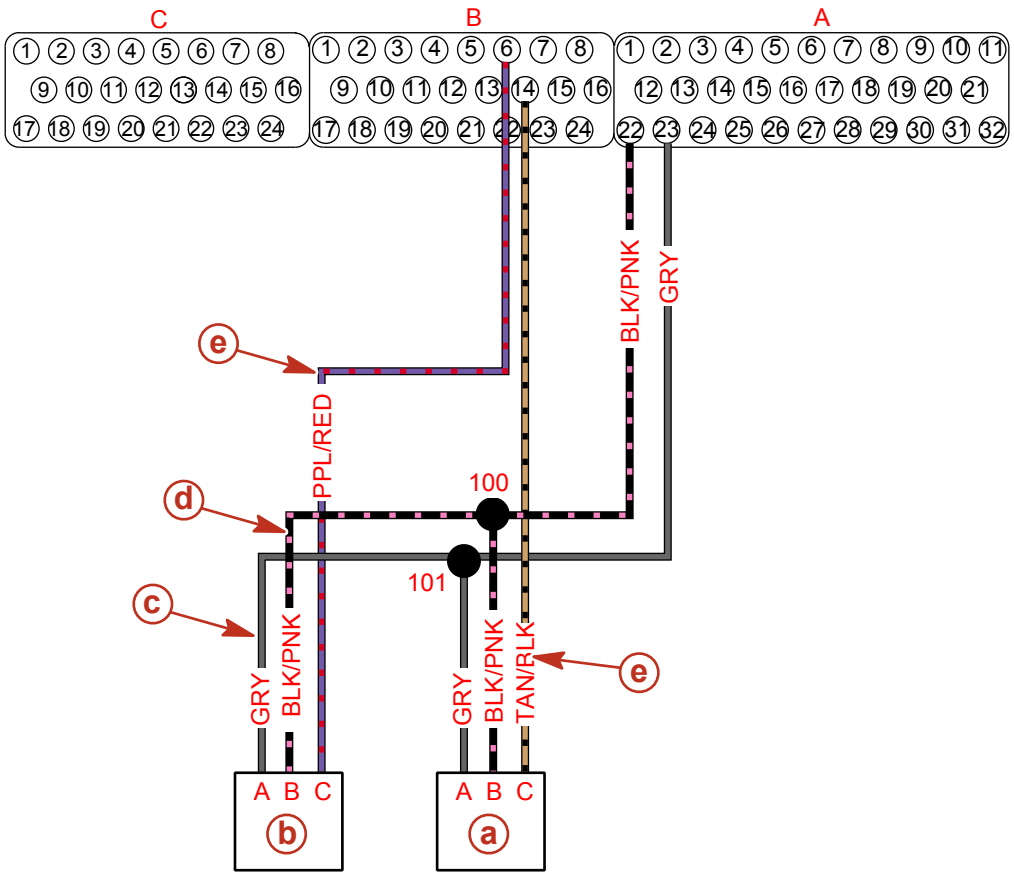
Control Area Network (CAN) Circuit—Mechanical



a - 14 Pin connector
b - Resistor block
c - PCM connector A

The CAN circuit provides data to all SmartCraft gauges and System View. The gauges receive power through the BUS power and ground. Gauge information (RPM, TEMP, TRIM) is sent through the CAN 1 leads.

Crank Position Sensor (CPS) and Camshaft Position Sensor (CMP) Circuits—Mechanical 496/8.1

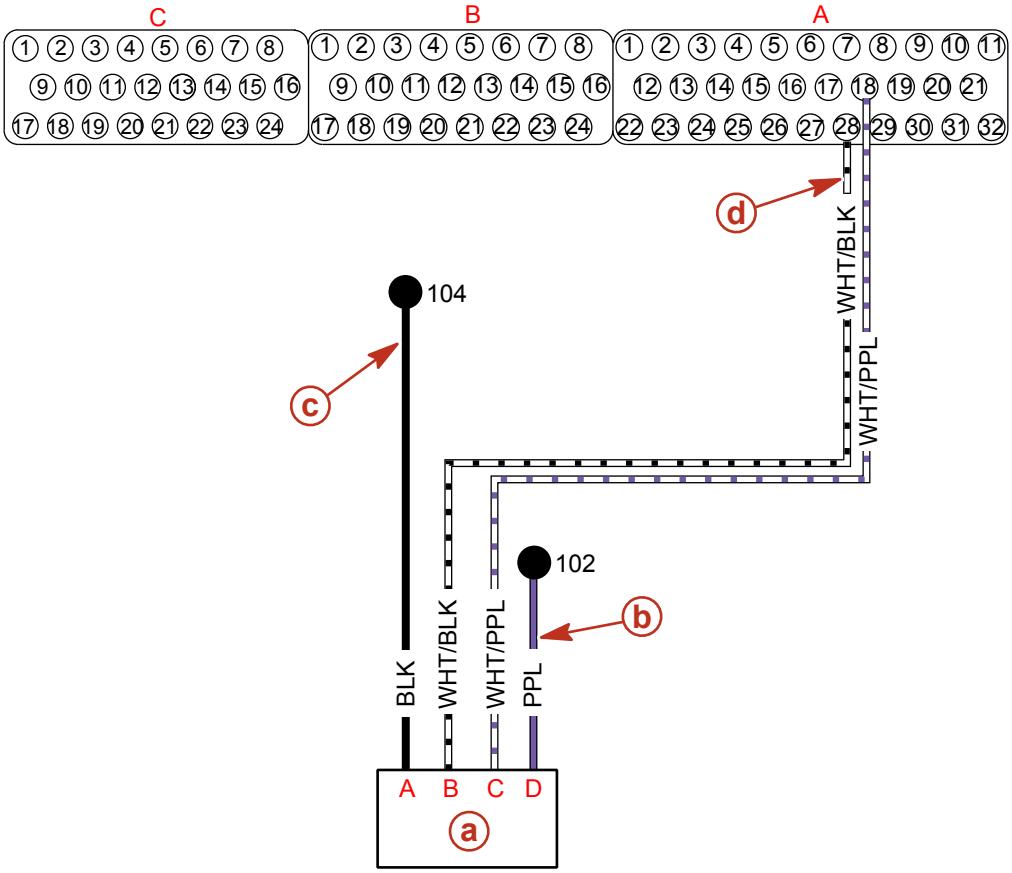


a - Crank position sensor (CPS)
b - Camshaft position sensor (CMP)
c - 5 Volt power
d - 5 Volt ground
e - Signal wire

If a failure occurs in these sensor circuits, the engine will operate extremely rough or stop operating. Check for continuity between the PCM and the sensor.

With software prior to level 091, a malfunction of the CPS or the CMP will not set a fault. With level 091 software, if the CMP is defective and does not send a signal to the PCM, the engine will backfire and not start. Stop cranking the engine when this occurs and then try to start the engine. Operate the engine for 20 seconds to set faults. The Audio Warning alarm will signal 2 beeps per minute. The SmartCraft system monitor will show check engine.

Diagnostics Circuit



17636

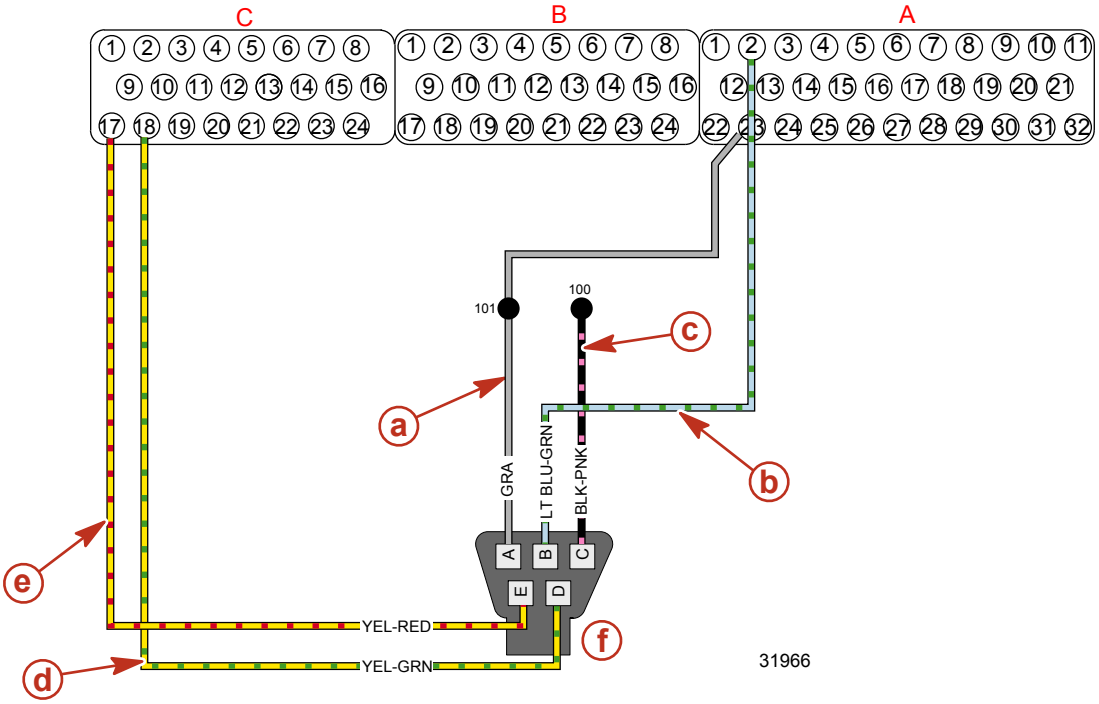
a - Data link connector
b - 12 Volt switched power
c - 12 Volt ground
d - Data leads from PCM

The data link connector (DLC) is a 4 pin circuit for attaching the diagnostic tool to the PCM. Before attaching a diagnostic tool to the engine, verify that the key is OFF and the pins are clean of corrosion and debris. Pin A is the 12 volt ground connected to the engine harness at splice 104. Pins B and C are data retrieval lines from the PCM. Pin D is the 12 volt supply to the diagnostic tool.

IMPORTANT: Diagnostic tools can only receive data with key on or engine operating. Diagnostic tools need a minimum of 8 volts. If the diagnostic tool does not respond, verify the connection, verify that the key is on, and check the battery voltage.

A malfunction of the data link connector will not set a fault.

Electronic Shift Control (ESC) Circuit—Sterndrive DTS

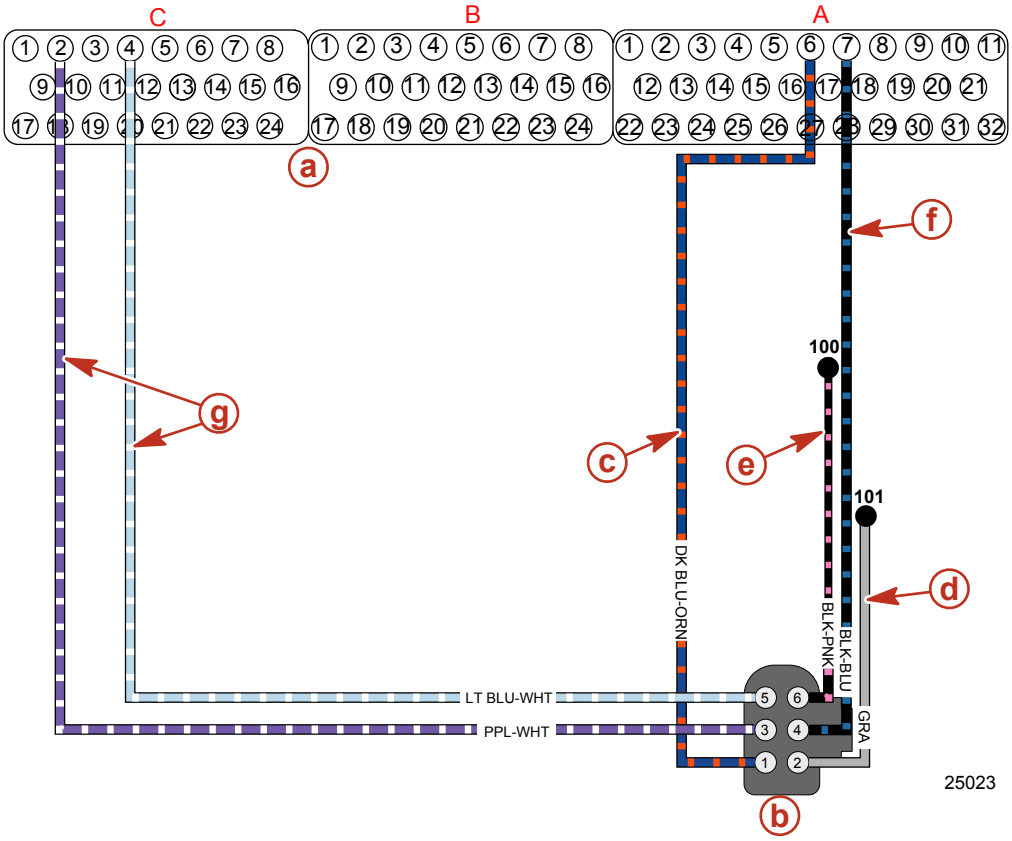


a - Power 1 (5 volt)
b - Shift position signal
c - Sensor ground (–)
d - Motor B—pin D
e - Motor A—pin E
f - ESC harness connector

The electronic shift control (ESC) shift actuator is used to shift the DTS engine gearcase into forward, neutral, and reverse gears without the use of mechanical cables from a shift/throttle control. The 12 VDC actuator motor rotates a ball screw assembly through reduction gears in the actuator. The screw shaft then extends or retracts the actuator shaft while at the same time the actuator reduction gear set rotates a potentiometer in the actuator housing. The potentiometer receives a reference voltage (5.0 volts) from the PCM, and the variable signal confirms the position of the actuator shaft.

A malfunction in the ESC circuit on a sterndrive model will set certain faults.

Electronic Throttle Control (ETC)—Sterndrive and Inboard DTS

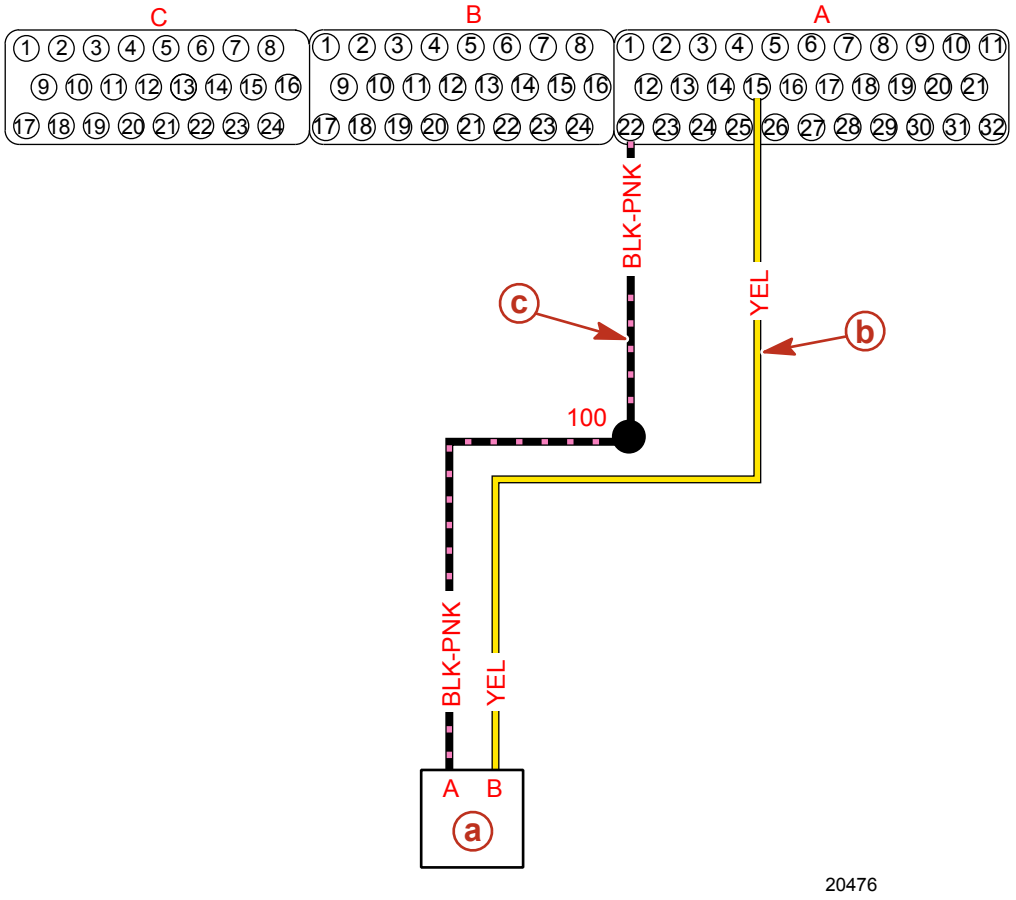


a - PCM connectors
b - Electronic throttle control
c - Signal wire TPS 1
d - 5 Volt power 1
e - 5 Volt ground
f - Signal wire TPS 2
g - Shift signal

A malfunction in the Throttle Position Sensor (TPS) circuit will set a fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo, ETC Sticking, TPS No Adapt, and TPS 1and 2 Difference Fault.

The TPS sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at wide open throttle on TPS 1 and 4.7 volts at idle to 0.5 volts at wide open throttle on TPS 2.

Engine Coolant Temperature Sensor (ECT) Circuit



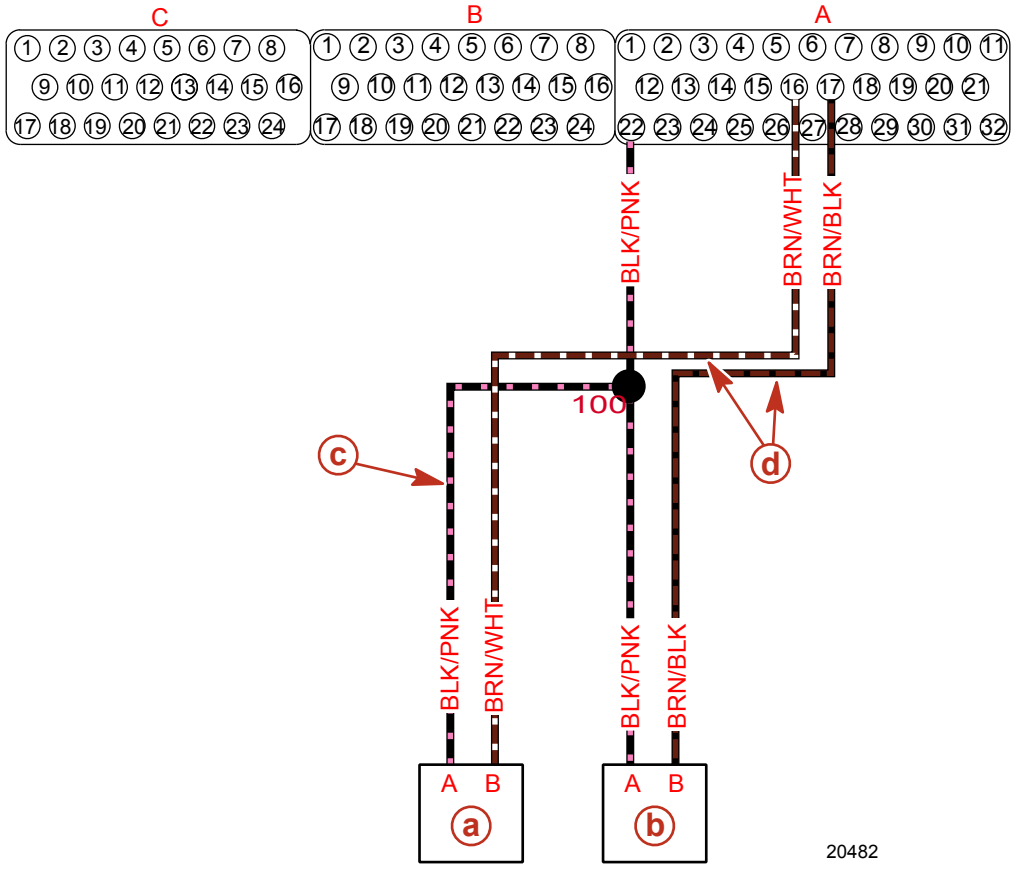
a - Engine coolant temperature sensor (ECT)
b - Signal wire
c - 5 Volt transducer ground

The ECT is a temperature sensor immersed in the engine coolant stream. It is located in the water crossover on the front starboard side of the engine. Low coolant temperature produces high resistance, while high temperature causes low resistance.

A malfunction of the ECT will set a fault of Cool TEMP CKT Hi, Cool TEMP CKT Lo or ECT Coolant Overheat.

Approximate Temperature-To-Resistance Values		
F°	**C°**	**ohms**
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

Exhaust Manifold Coolant Temperature (EMCT) Sensor Circuits–496/8.1

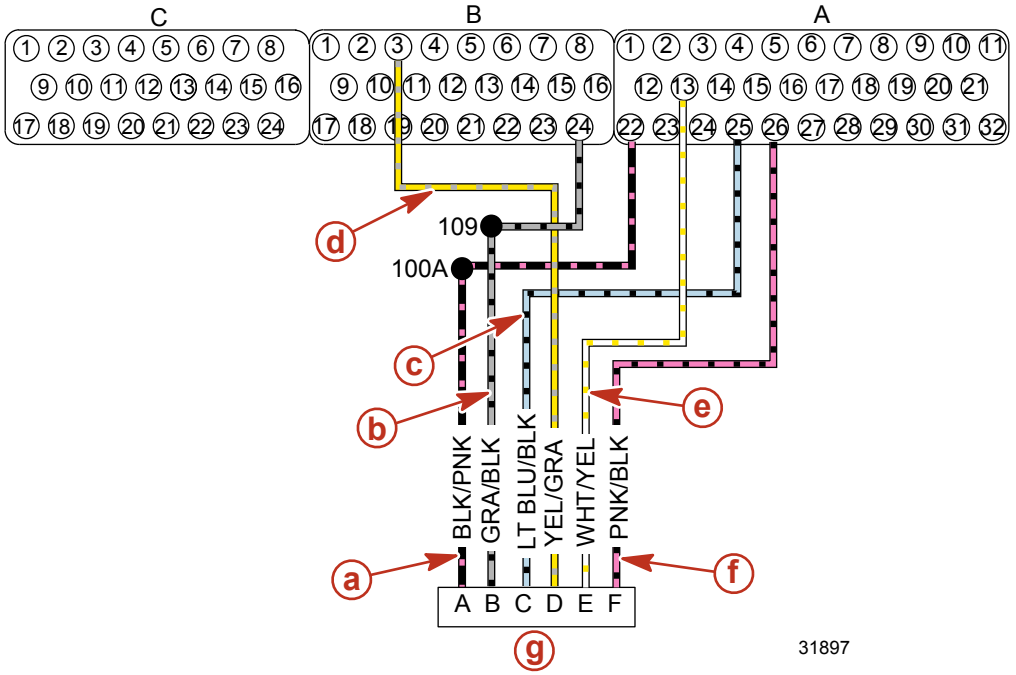


a - Port (odd) EMCT
b - Starboard (even) EMCT
c - 5 Volt transducer ground
d - Signal wires

The exhaust manifold coolant temperature (EMCT) sensors are located on the top of each exhaust manifold. The EMCT sensors are thermistors immersed in the engine coolant stream. Low temperatures produce high resistance, while high temperatures cause low resistance.

A malfunction of the EMCT will set a fault of Port EMCT CKT Hi, Port EMCT CKT Lo, Port EMCT CKT Overheat, STB EMCT CKT Lo, STB EMCT CKT Hi or STB EMCT CKT Overheat.

Fuel Level Sensor Circuit—Harness 84-865457A05 and 84-865457A06

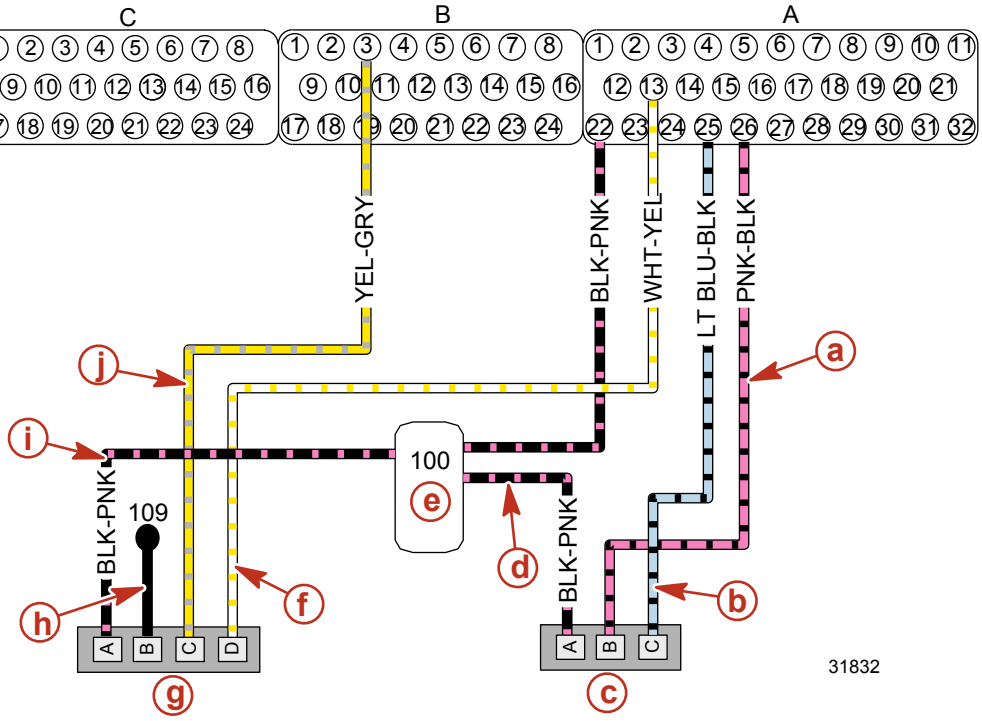


a - 5 Volt transducer ground
b - Power 2 (SmartCraft sensors)
c - Fuel level 2
d - Paddle wheel signal
e - Seawater temperature signal
f - Fuel level 1
g - 6 Pin connector

The fuel level sensor circuit supplies the PCM with fuel level information. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Level Sensor Circuit—Harness 84-865458A01

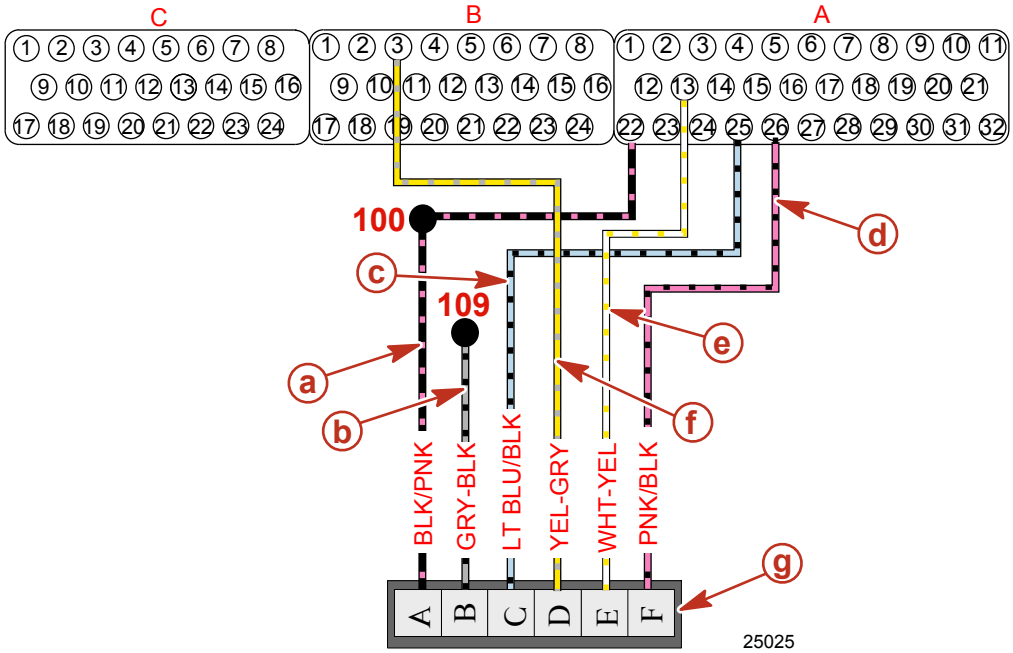


a - Fuel level 1
b - Fuel level 2
c - Fuel level 1 and 2 connector
d - 5 Volt transducer ground
e - Splice 100
f - Seawater temperature signal
g - Paddle wheel and seawater temperature connector
h - Splice 109
i - 5 Volt transducer ground
j - Paddle wheel signal

The fuel level sensor circuit supplies the PCM with fuel level information. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Level Sensor Circuit—Harnesses 84-865653A03 and 84-865653A04

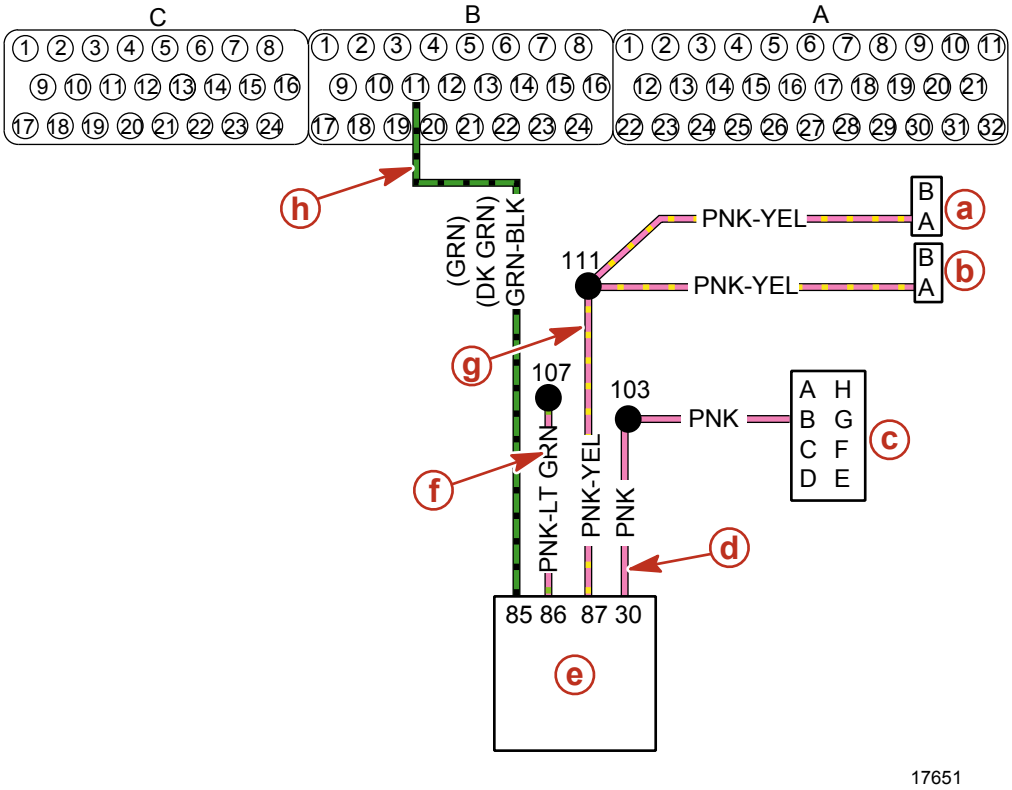


a - 5 Volt transducer ground
b - Splice 109
c - Fuel level 2
d - Fuel level 1
e - Seawater temperature sender
f - Paddle wheel signal
g - Fuel and paddle wheel connector

The fuel level sensor circuit supplies the PCM with the fuel level. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

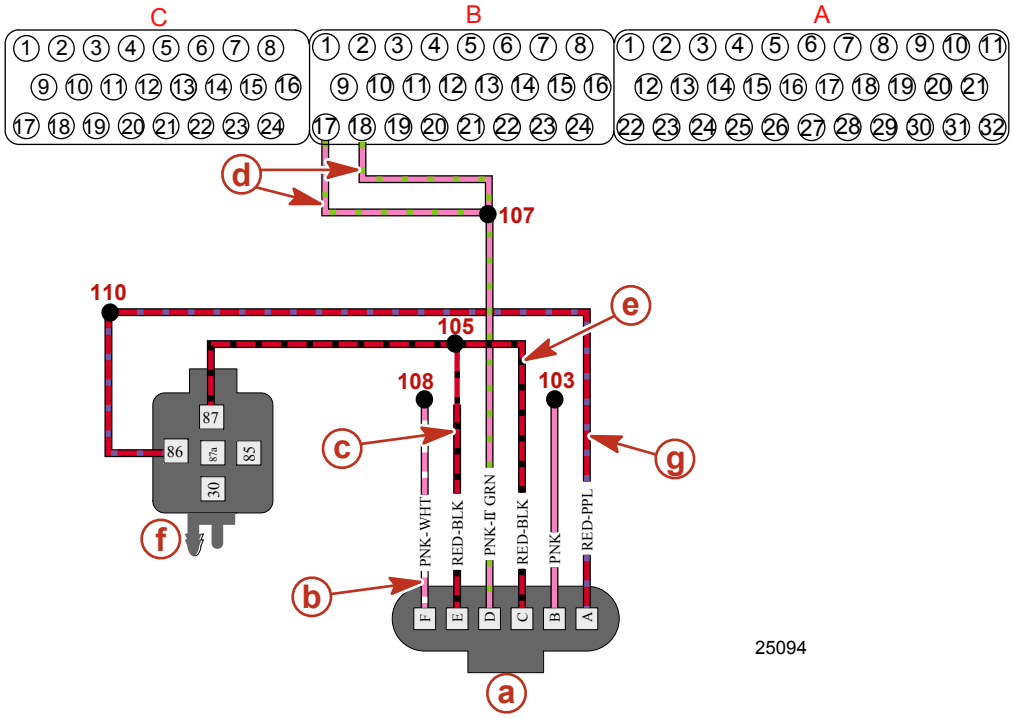
Fuel Pump Relay Circuit



a - Cool fuel pump
b - Booster fuel pump (if equipped)
c - Fuses
d - 12 volt from fuses
e - Fuel pump relay
f - 12 volt to splice 107
g - 12 volt to splice 111
h - Signal from PCM

When the key switch is turned to the on position, the fuel pump relay receives 12 V battery power through the fuses at terminal 30. The PCM signals the relay that powers both fuel pumps. Listen at key on for both fuel pumps to run for 3 seconds.

Fuse Circuit—DTS

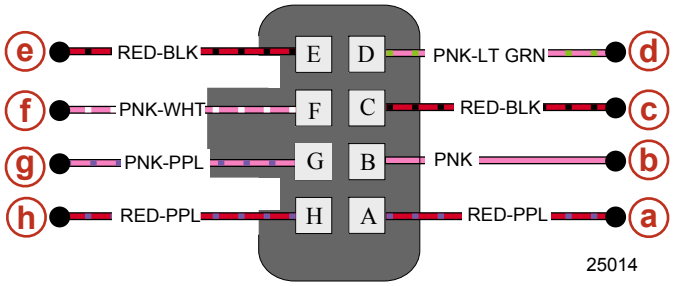


a - Fuses
b - 12 Volt power to fuel injectors
c - Battery power
d - 12 Volt power to PCM
e - Battery power
f - Fuel pump relay
g - Battery power

The fuse circuit receives 12 V battery power through splices 110 and 105. The fuse circuit is located on the upper port side of the engine. The protected power is sent to the PCM, fuel injectors, and fuel pump relay.

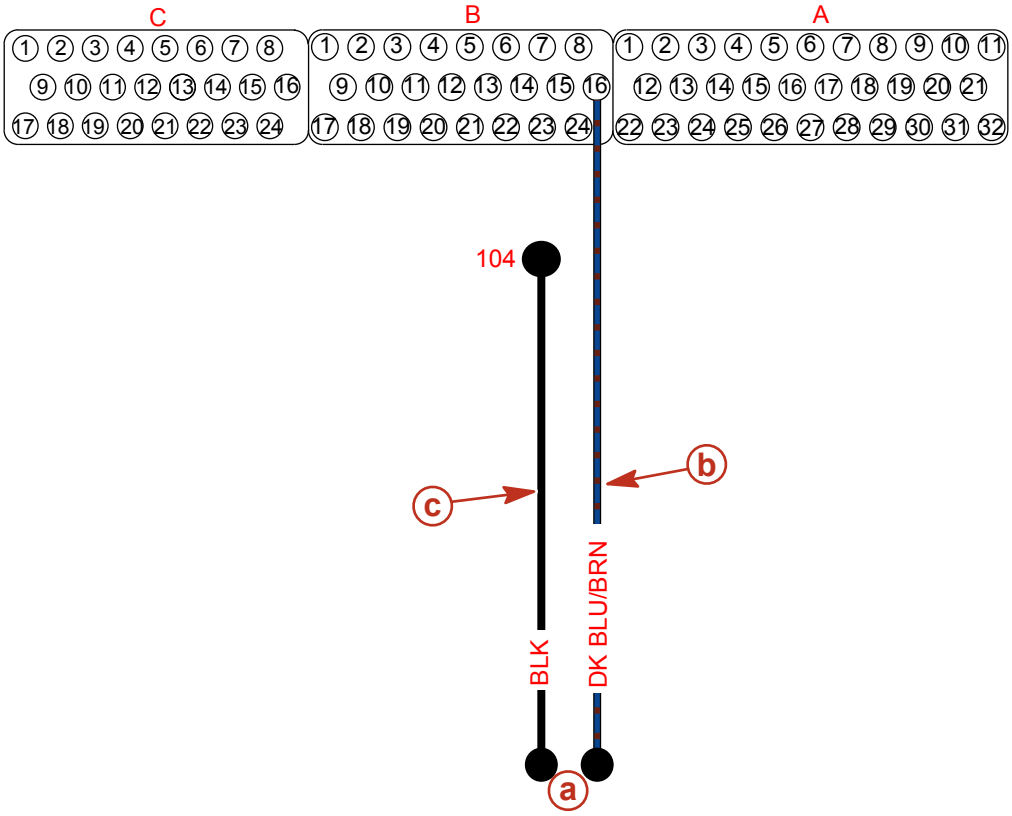
A malfunction in the fuse circuit will not set a fault.

Fuse Circuit—Mechanical



a - Splice 110
b - Splice 103
c - Splice 105
d - Splice 107
e - Splice 105
f - Splice 108
g - Splice 103A
h - Splice 110

Gear Lube Monitor or Transmission Overtemp Circuit



a - Connector to drive lube monitor (sterndrive) or transmission temperature sensor (inboard)

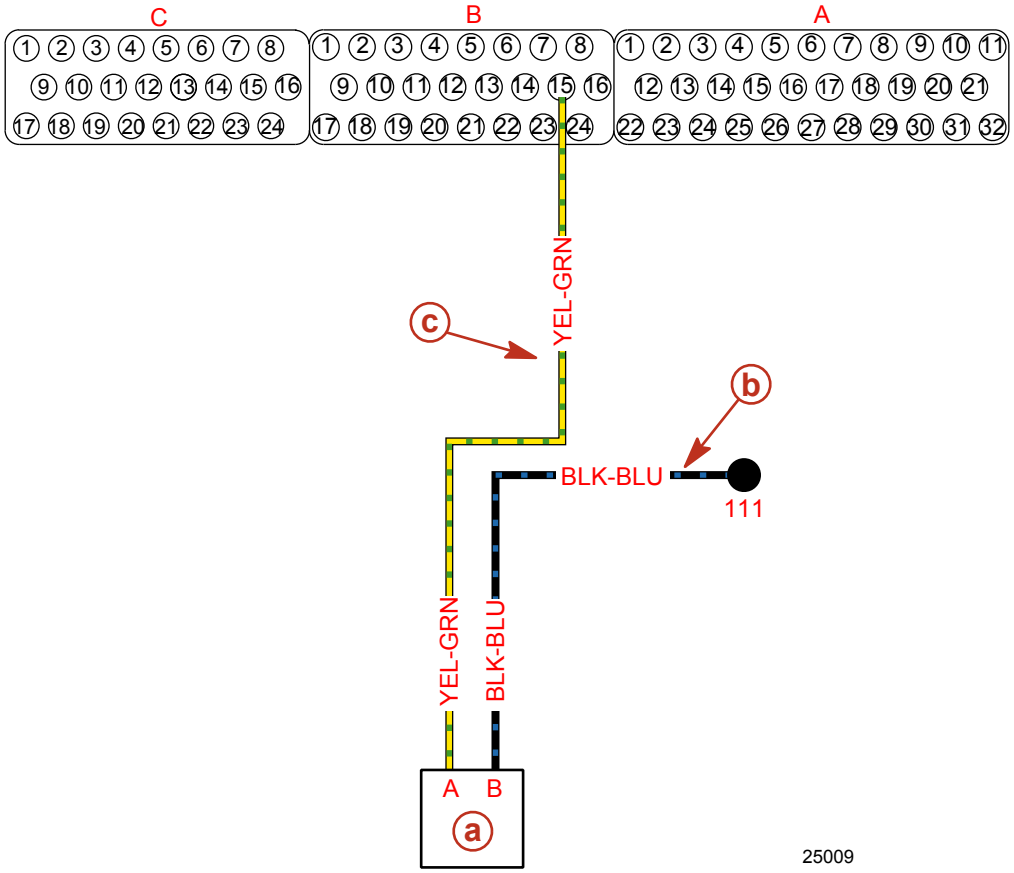
b - Signal wire

c - Ground

The gear lube monitor circuit is an open-continuity circuit. It is located on the top port side of the engine. The circuit will show continuity if the level of fluid in the monitor is low. If a problem is suspected, check continuity. There should be continuity with an empty monitor and no continuity with a full monitor.

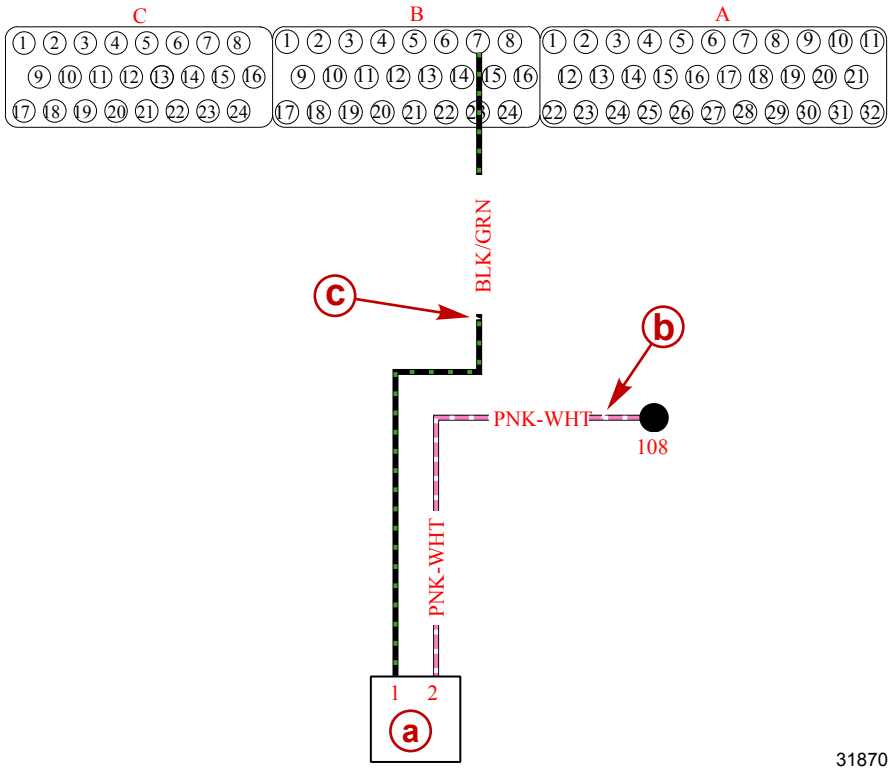
A low level of fluid in the gear lube monitor will set a fault of Low Drive Lube Strategy.

Gear Position Switch



a - Gear position switch connector
b - 5 Volt ground
c - Signal wire

Idle Air Control Valve (IAC) Circuit—14 Pin



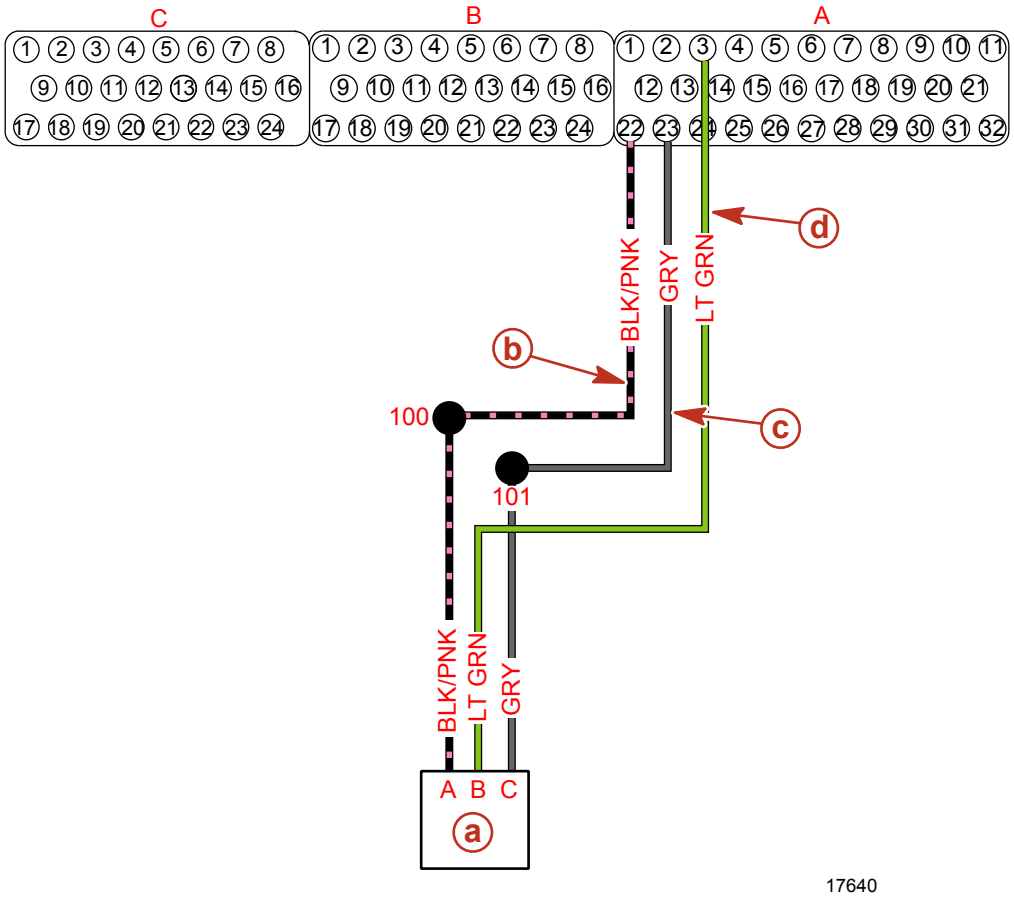
a - IAC sensor connector
b - 12 Volt transducer power from MPR
c - Signal wire

The idle air control valve (IAC) is a 12 volt circuit powered by the MPR. It is located at the top rear of the engine.

A malfunction of the IAC will set a fault of IAC Output.

The IAC circuit is not used with the DTS.

Manifold Absolute Pressure Sensor (MAP) Circuit—496/8.1

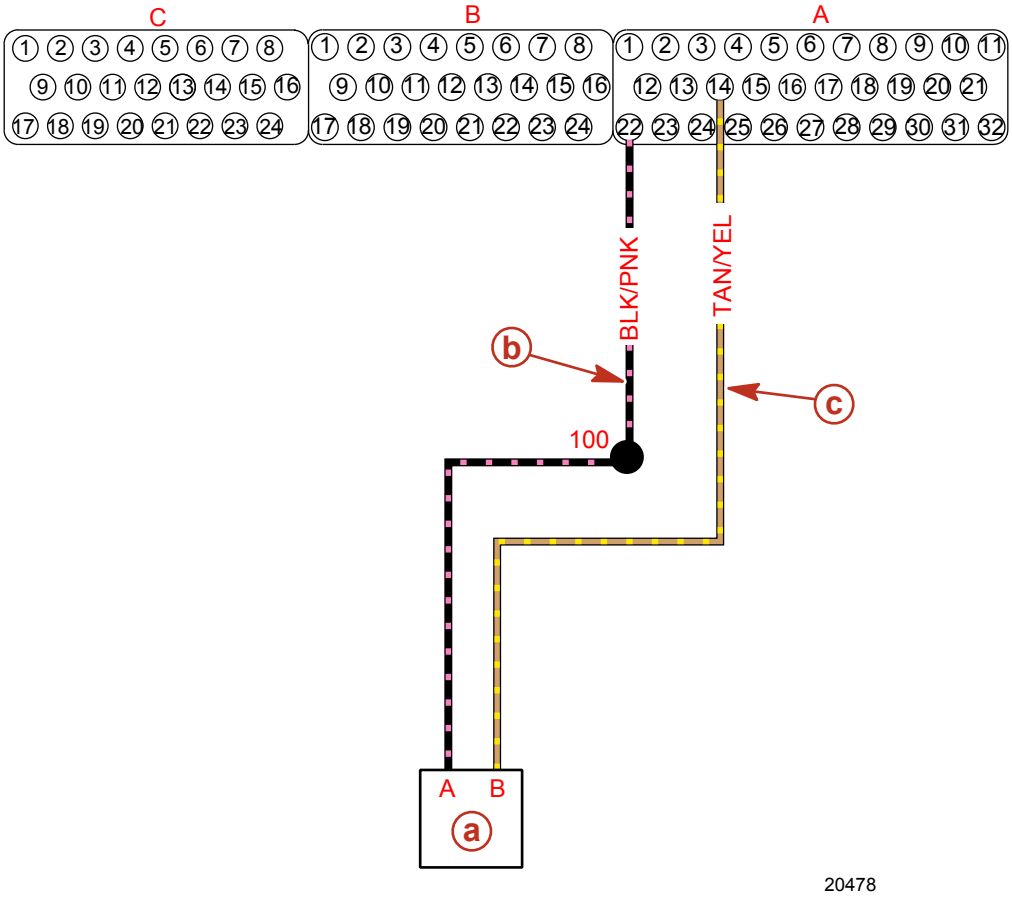


a - MAP connector
b - 5 Volt ground
c - 5 Volt power
d - Signal wire

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure. It is located on the intake manifold on the top of the engine. At key on, the MAP is equal to atmospheric pressure. This information is used by the PCM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading with a known good MAP sensor is a good check of a suspect sensor. The pressure changes as a result of engine load and speed change. The PCM receives this information as a signal voltage that will vary from about 1.0-2.0 volts at idle to about 4.0-5.0 volts at WOT.

A malfunction in the MAP sensor circuit could set the fault of MAP Sensor Input HI, MAP Sensor Input Lo or MAP Sensor Idle Rationale.

Manifold Air Temperature Sensor (MAT) Circuit—496/8.1

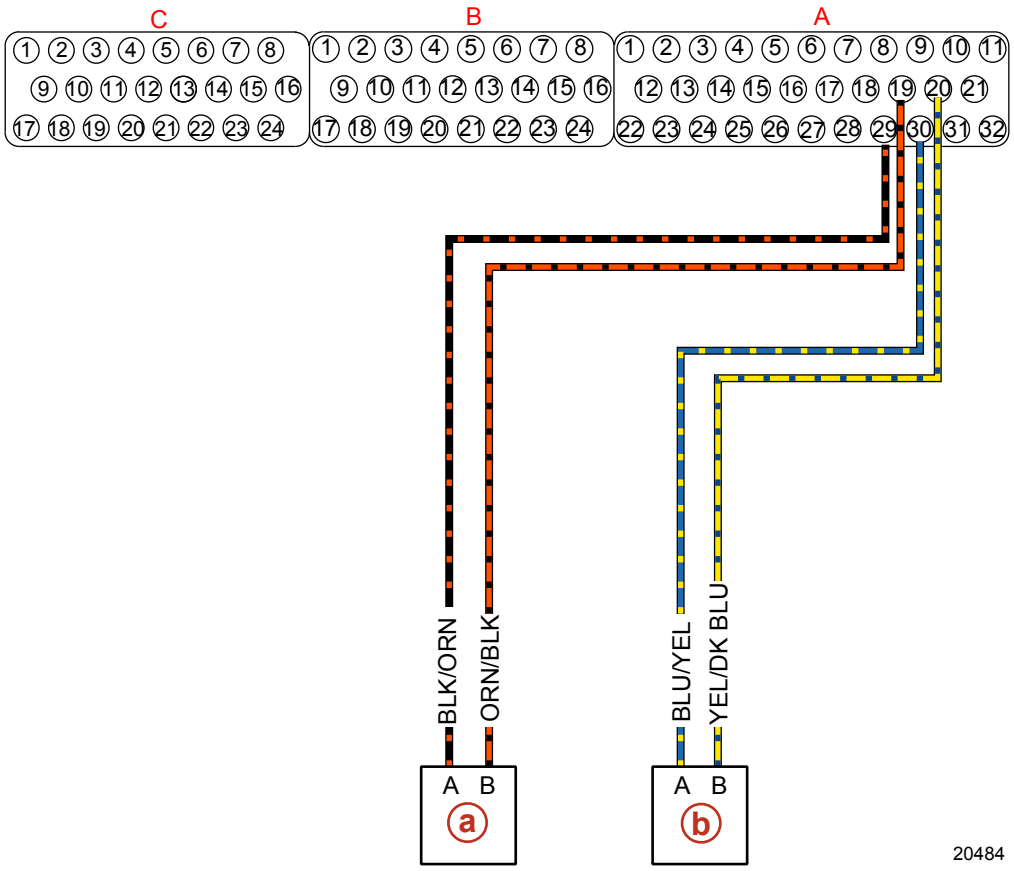


a - MAT connector
b - 5 Volt ground
c - Signal wire

The manifold air temperature sensor (MAT) is a thermistor that controls signal voltage to the PCM. It is located at the rear of the engine in the intake manifold plenum. When intake air is cold, the sensor resistance is high. As the air temperature rises, resistance lowers.

A malfunction in the MAT will set the fault of AIR TMP CKT Hi or AIR TMP CKT Lo.

Odd and Even Knock Sensor Circuits—Harness 84-865458A01 and 84-865653A03

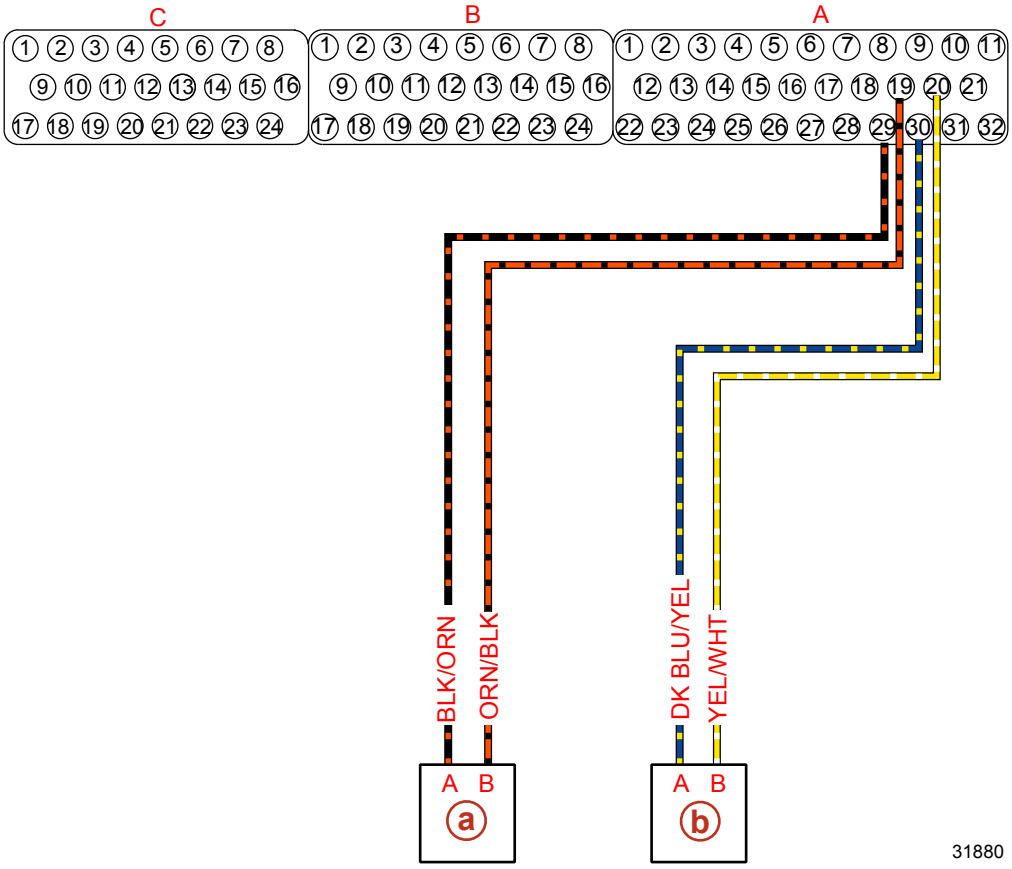


a - Odd knock sensor
b - Even knock sensor

Knock sensors detect engine detonation or spark knock and send a voltage signal to the PCM. The knock sensors are located on the lower half of the engine on the odd (port) and even (starboard) sides. As the sensor detects knock, the voltage output level increases and signals the PCM.

An unacceptable knock sensor reading will set a fault of Knock Sensor HI or Knock Sensor LO.

Odd and Even Knock Sensor Circuits—Harness 84-865457A06 and 84-865653A04

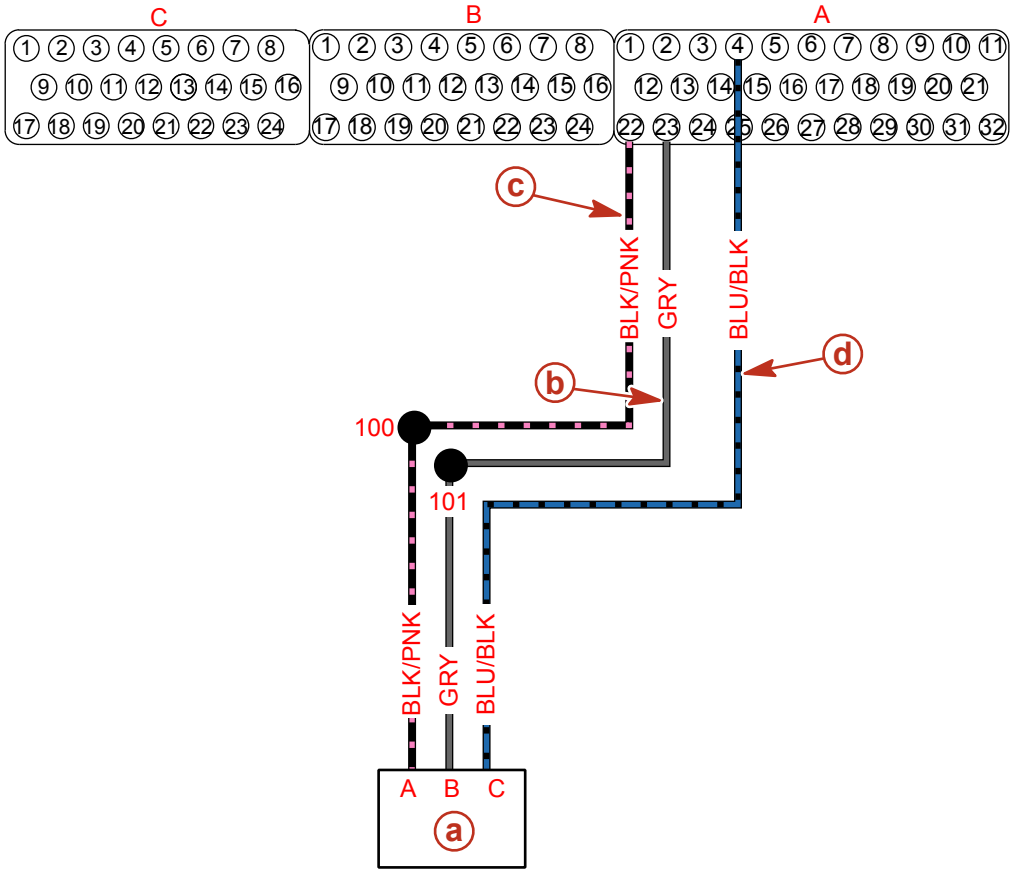


a - Odd knock sensor
b - Even knock sensor

Knock sensors detect engine detonation or spark knock and send a voltage signal to the PCM. The knock sensors are located on the lower half of the engine on the odd (port) and even (starboard) sides. As the sensor detects knock, the voltage output level increases and signals the PCM.

An unacceptable knock sensor reading will set a fault of Knock Sensor HI or Knock Sensor LO.

Oil Pressure Sensor Circuit

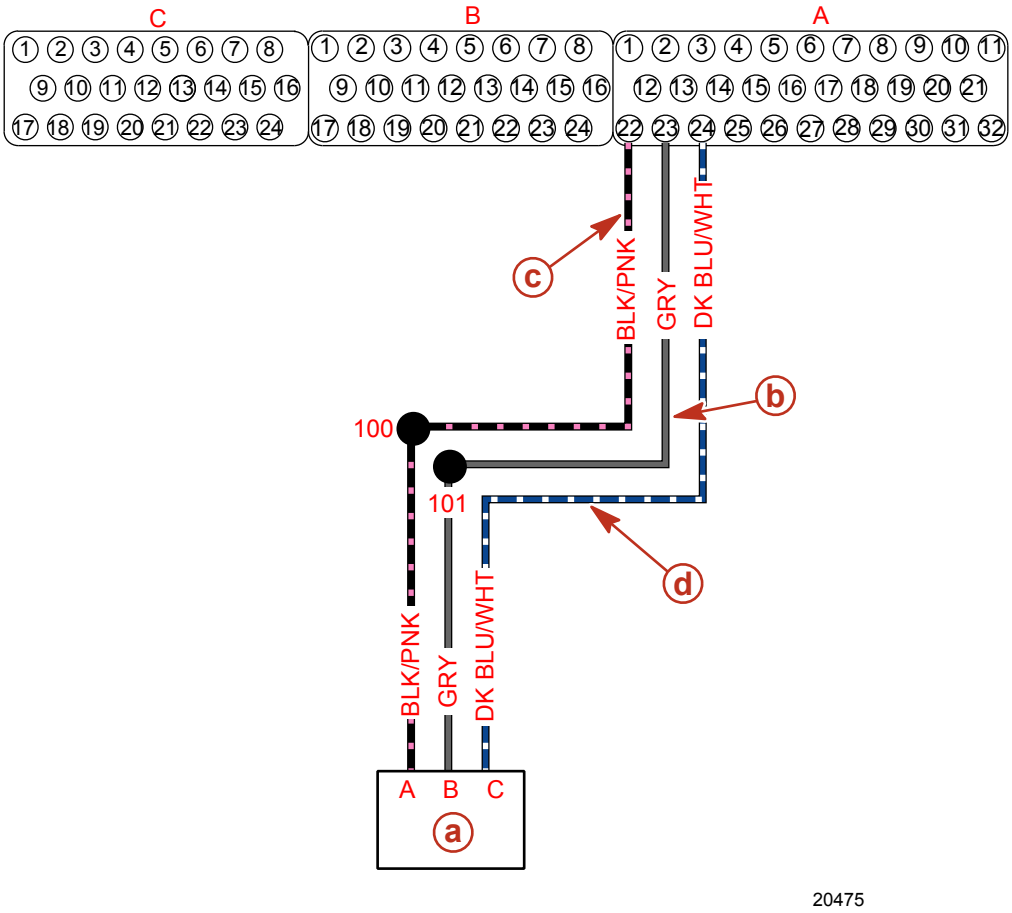


a - Oil pressure sensor
b - 5 volt power
c - 5 volt ground
d - Signal to the PCM

The oil pressure sensor measures oil pressure in the oil galleries. The sensor is located on the rear port side of the engine.

A malfunction of the oil pressure sensor will set the fault Oil PSI CKT Hi, Oil PSI CKT Lo or Oil PSI Lo.

Seawater Pump Circuit

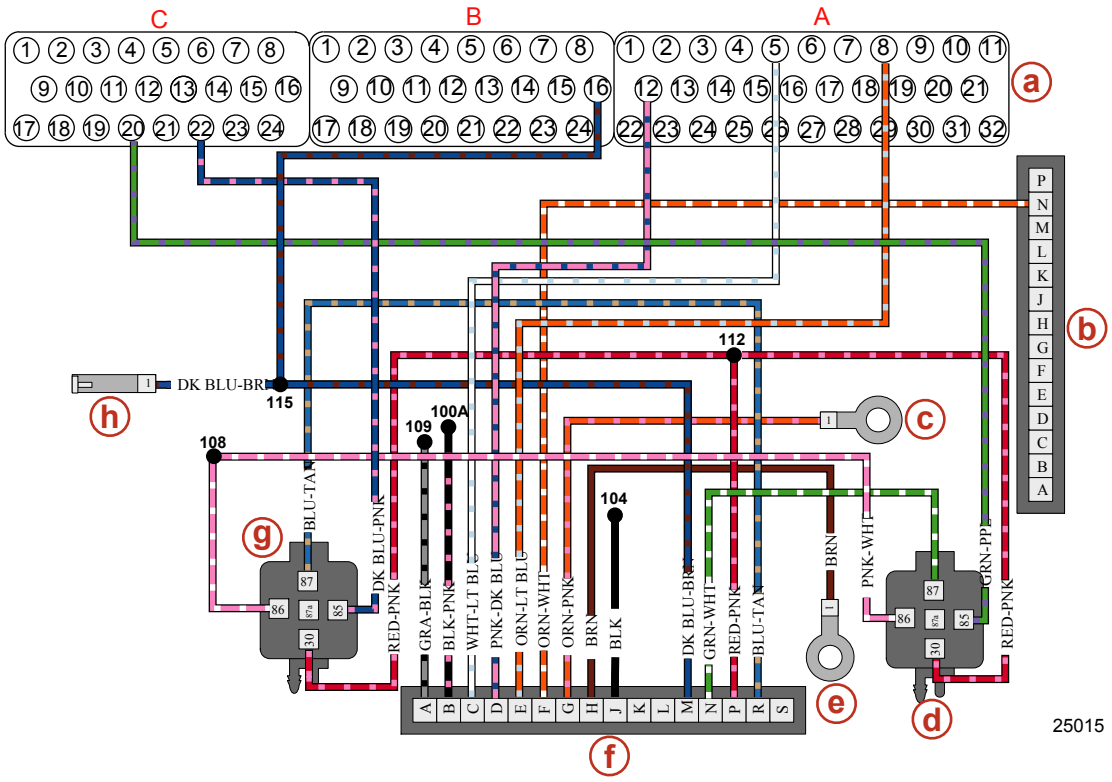


a - Seawater pump sensor connector
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The seawater pump sensor measures water inlet pressure or water block pressure. Normal diagnostic tool ranges are 7-34 kPa (1-5 psi) at idle and 48-117 kPa (7-17 psi) at WOT.

A malfunction of the seawater pump sensor will set the fault of Seapump CKT Hi, Seapump CKT Lo or Seapump PSI Lo.

Smart Transom Circuit—DTS Sterndrive



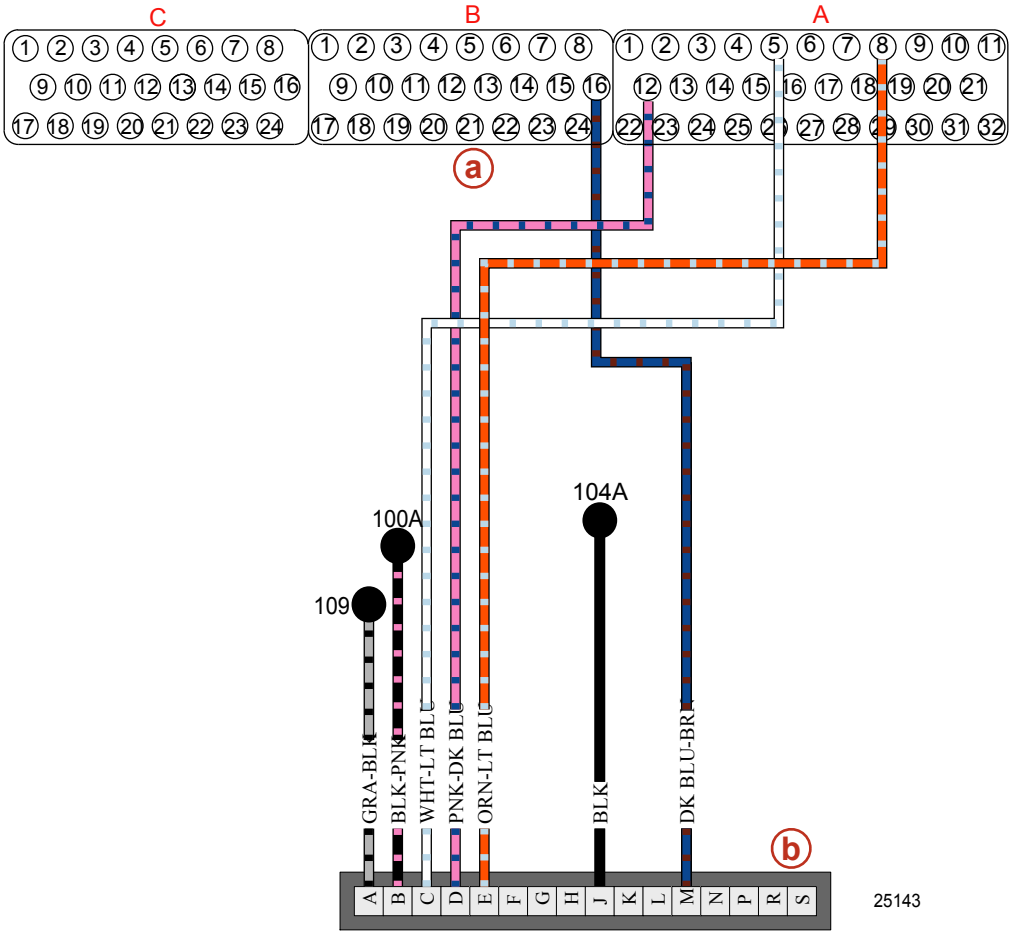
a - PCM connector A
b - 14 pin connector
c - MerCathode anode
d - Trim down relay
e - Mercathode reference electrode
f - Transom connector
g - Trim-up relay
h - Lube

The smart transom harness connection is located at the top of the engine. The harness controls communication between the transom sensors and the PCM. Pin A supplies 5 V power to the trim position sensor, pitot, and steering.

A malfunction in the smart transom circuit will set a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo, or many other faults.

The trim and Mercathode components are connected through the transom connector.

Smart Transom Circuit—DTS Inboard

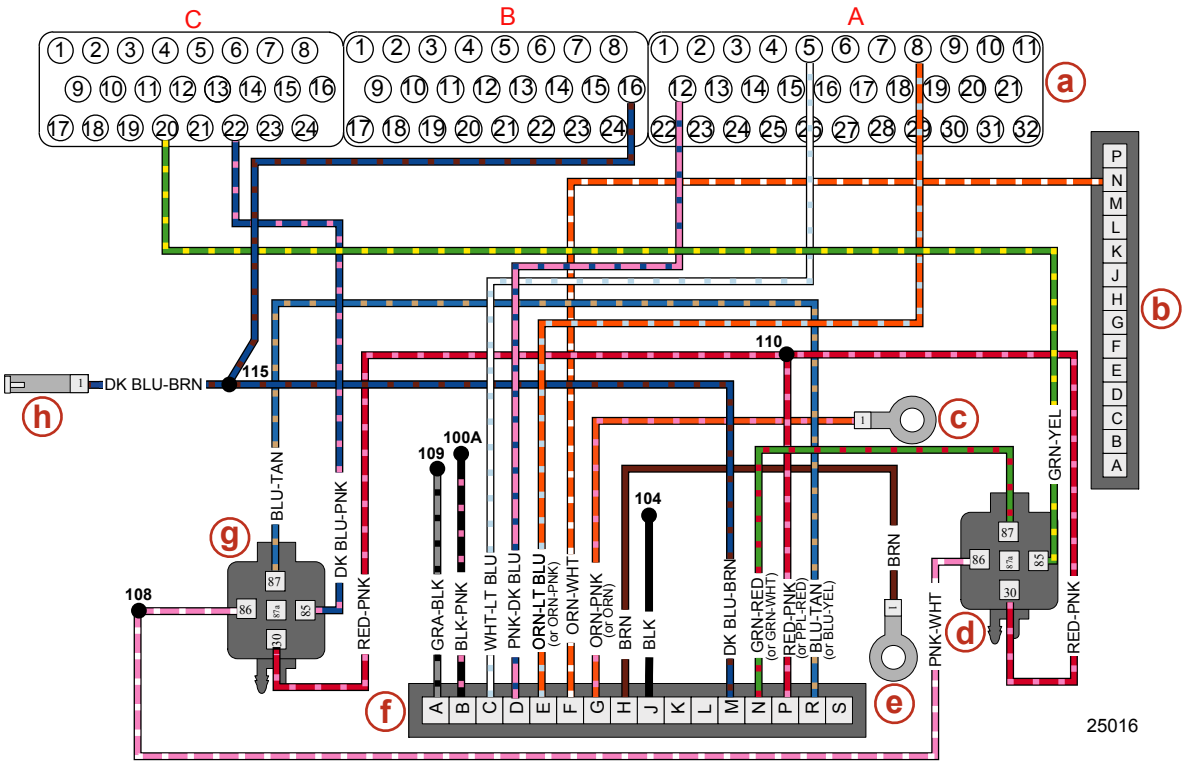


a - PCM connectors

b - 16 Pin smart transom connector

Smart Transom Circuit (Engine Harness)—Mechanical

NOTE: *This diagram applies to 496/8.1L sterndrive and inboard, and 5.0, 5.7, and 6.2L sterndrives.*

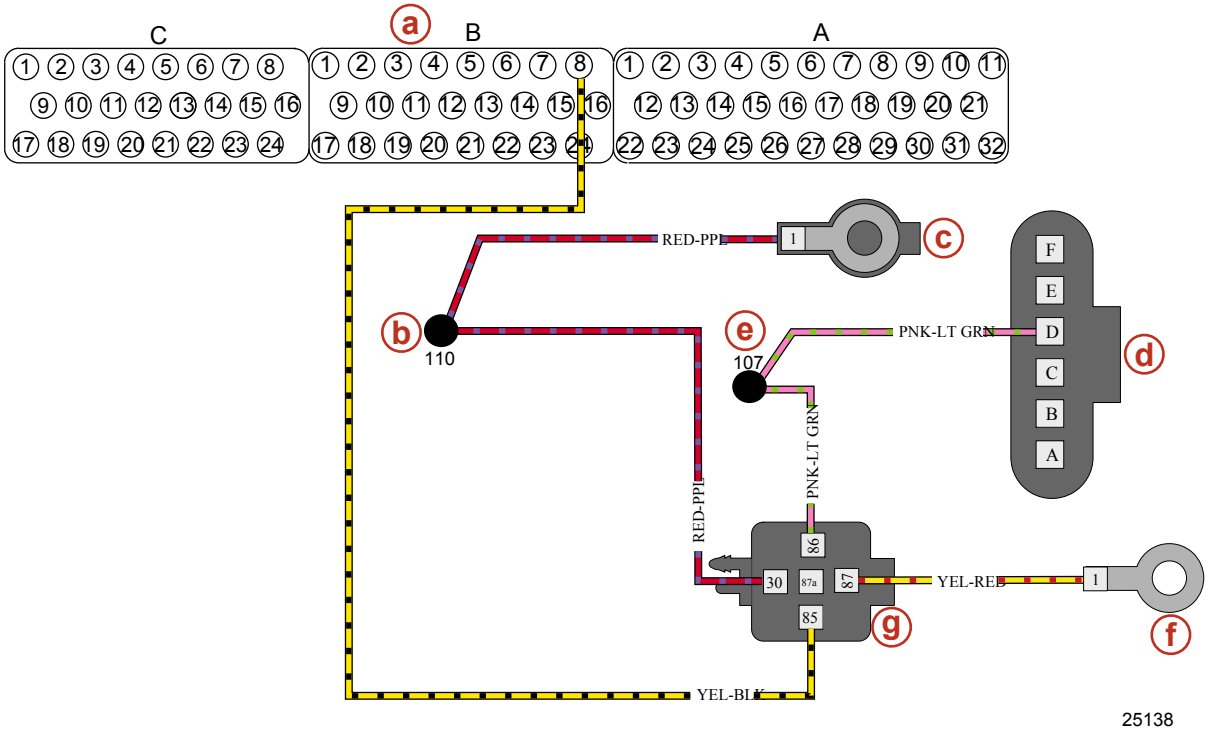


a - PCM Connector
b - 14 pin connector
c - Mercathode anode
d - Starter solenoid relay
e - Mercathode electrode
f - Transom harness connector
g - Trim-up relay
h - Lube

The smart transom harness connection is located at the rear of the engine on the upper port side. It controls communication between the transom sensors and the PCM. Pin A supplies 5 V power to the trim position sensor, pitot, and steering.

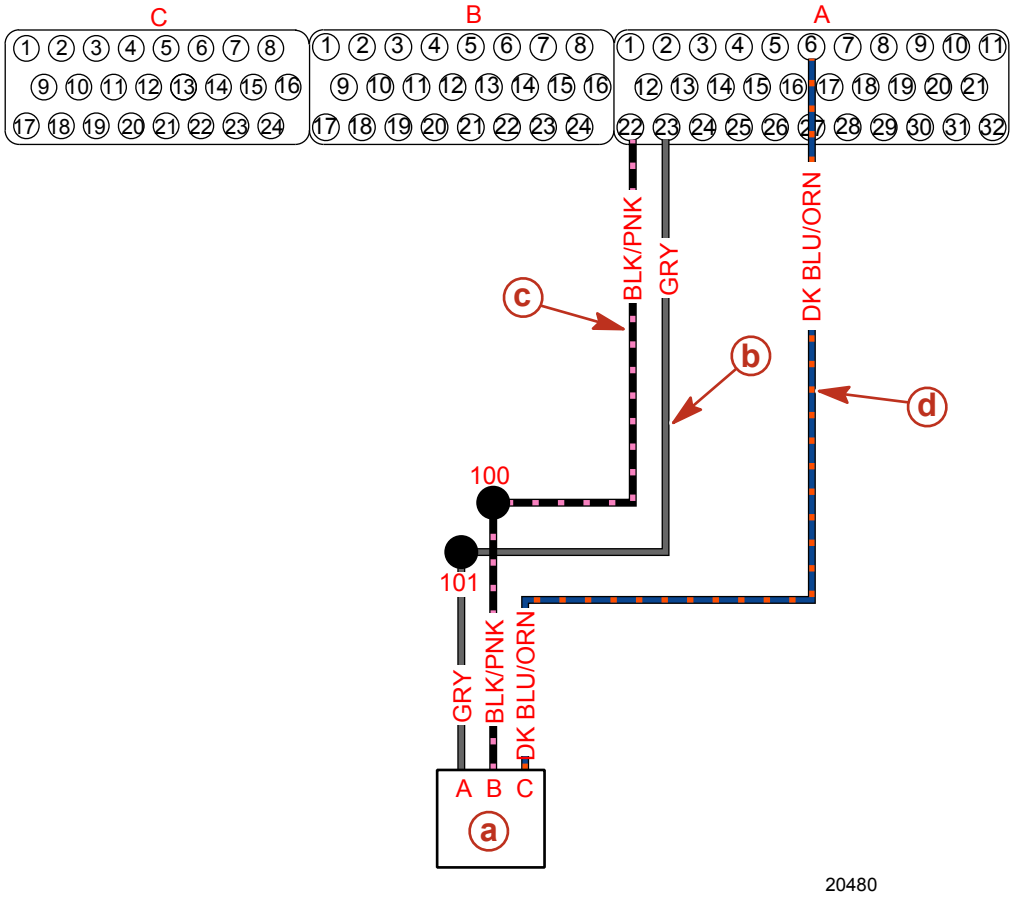
A malfunction in the smart transom circuit sets a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo.

Start Relay Circuit—DTS



a - PCM connector B
b - Splice 110
c - Circuit breaker, 50A
d - Fuse block
e - Splice 107
f - Starter "S" stud
g - Starter relay

Throttle Position Sensor (TPS) Circuit

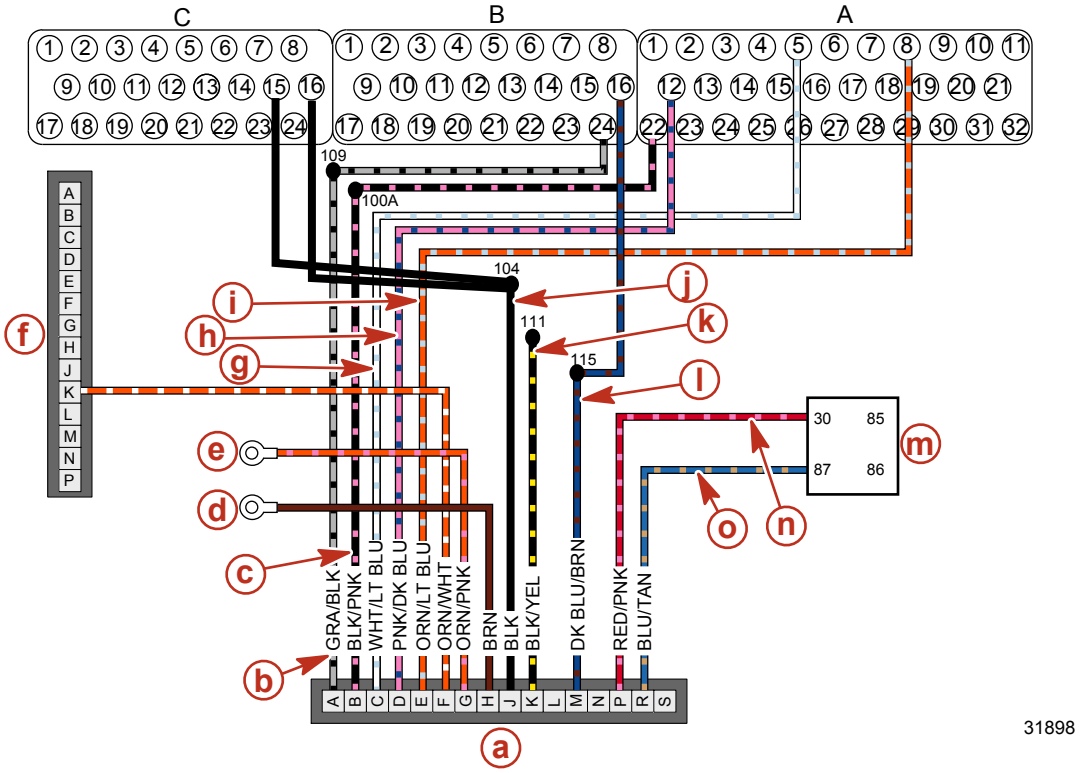


a - Throttle position sensor (TPS)
b - 5 Volt transducer power
c - 5 Volt transducer ground
d - Signal to PCM

The throttle position sensor (TPS) sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at WOT. If the TPS malfunctions, the ECM will reset to a default value.

A malfunction in the TPS circuit will set the fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo.

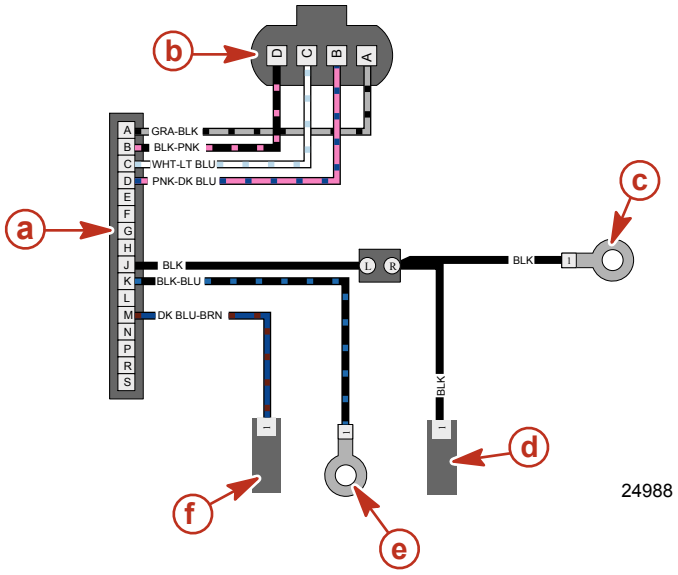
Transom Circuit (Engine Harness)—84-865457A06



a - Engine harness connector (to transom harness connector)
b - Power 2 (SmartCraft sensors)
c - Sender ground
d - MerCathode electrode
e - MerCathode anode
f - To 14 pin connector
g - Pitot signal
h - Steering position (Smart Transom)
i - Digital trim signal
j - Ground (–)
k - Start relay (terminal 86)
l - Drive lube monitor or transmission temperature switch
m - Trim up relay
n - 12 Volt power to Smart Transom
o - Trim up signal

The engine harness transom connector is located at the top of the engine. The harness circuits control communication between the transom harness sensors and the PCM.

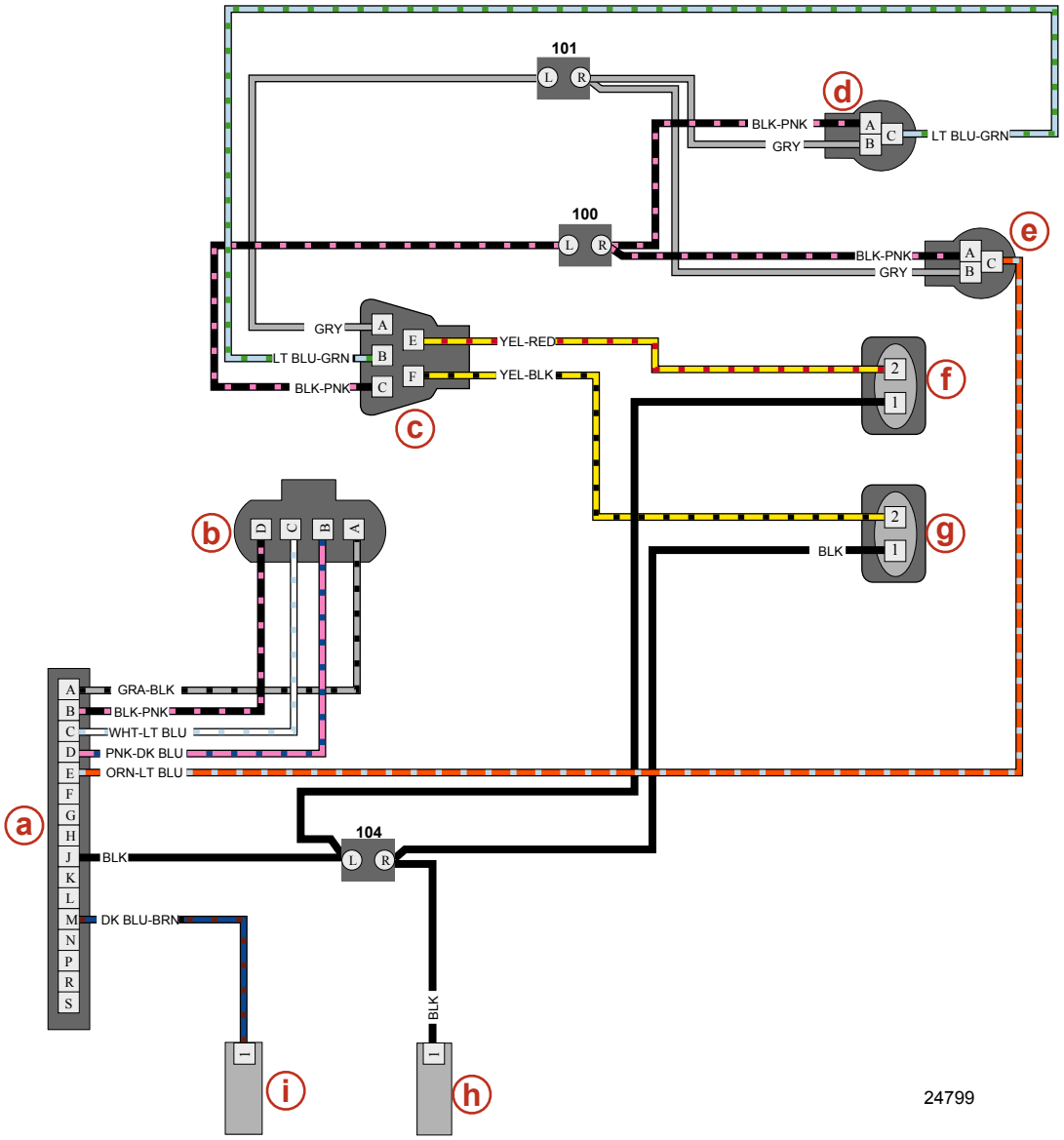
Transom Circuit (Transom Harness)—8.1, Inboard Mechanical



a - Transom harness to engine harness connector
b - Paddle wheel and pitot
c - Neutral ground
d - Transmission overtemp ground
e - Neutral switch
f - Transmission overtemp switch

NOTE: *An additional accessory harness is required for the paddle wheel and pitot connector.*

Transom Circuit (Transom Harness)—Inboard DTS

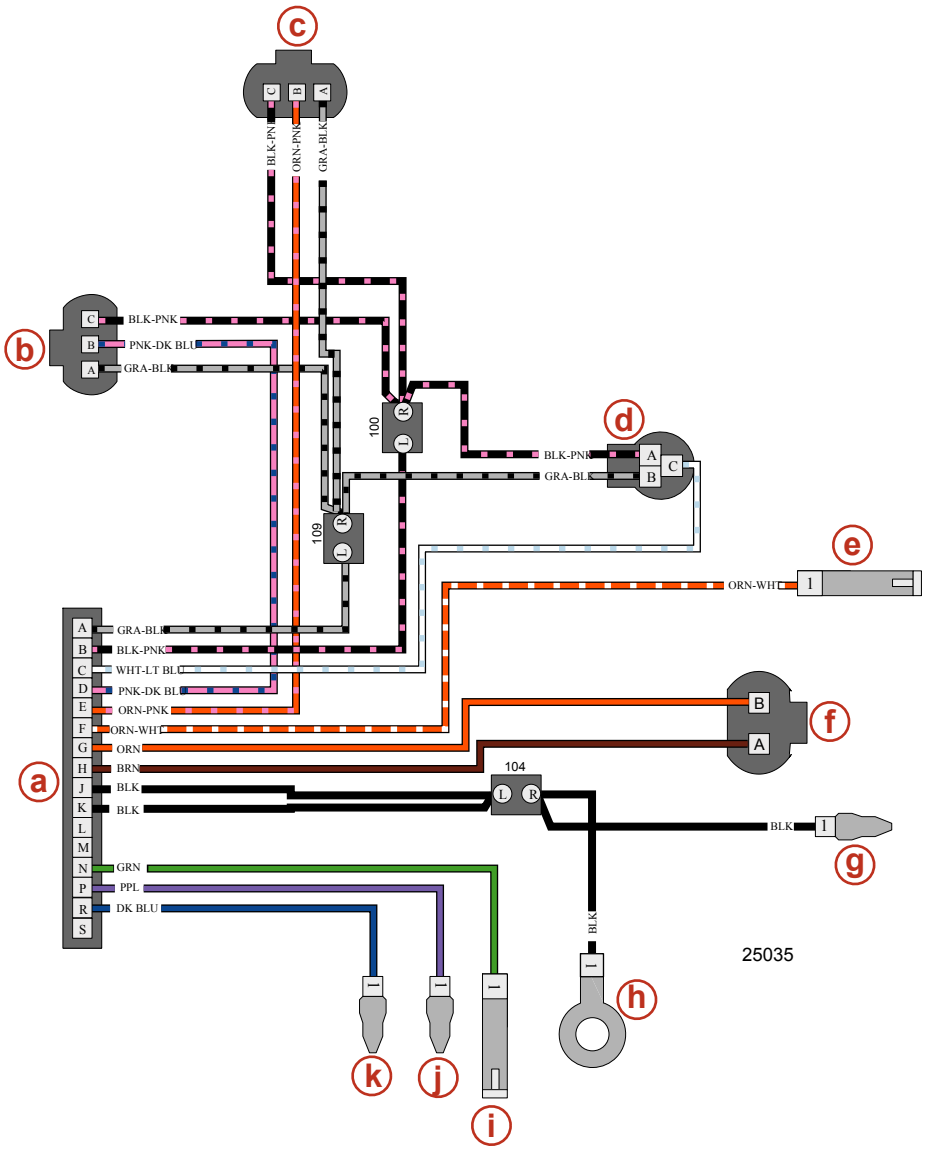


a - 16 Pin connector
b - Steering and pitot connector
c - Transmission shift harness connector (ESC)
d - Pressure A connector
e - Pressure B connector
f - Shift solenoid A connector
g - Shift solenoid B connector
h - Overtemp switch ground (–)
i - Transmission overtemp switch

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the EFI harness and the transmission.

A malfunction in the transom harness will show pressure faults and shift faults.

Transom Circuit (Transom Harness)—Sterndrive DTS

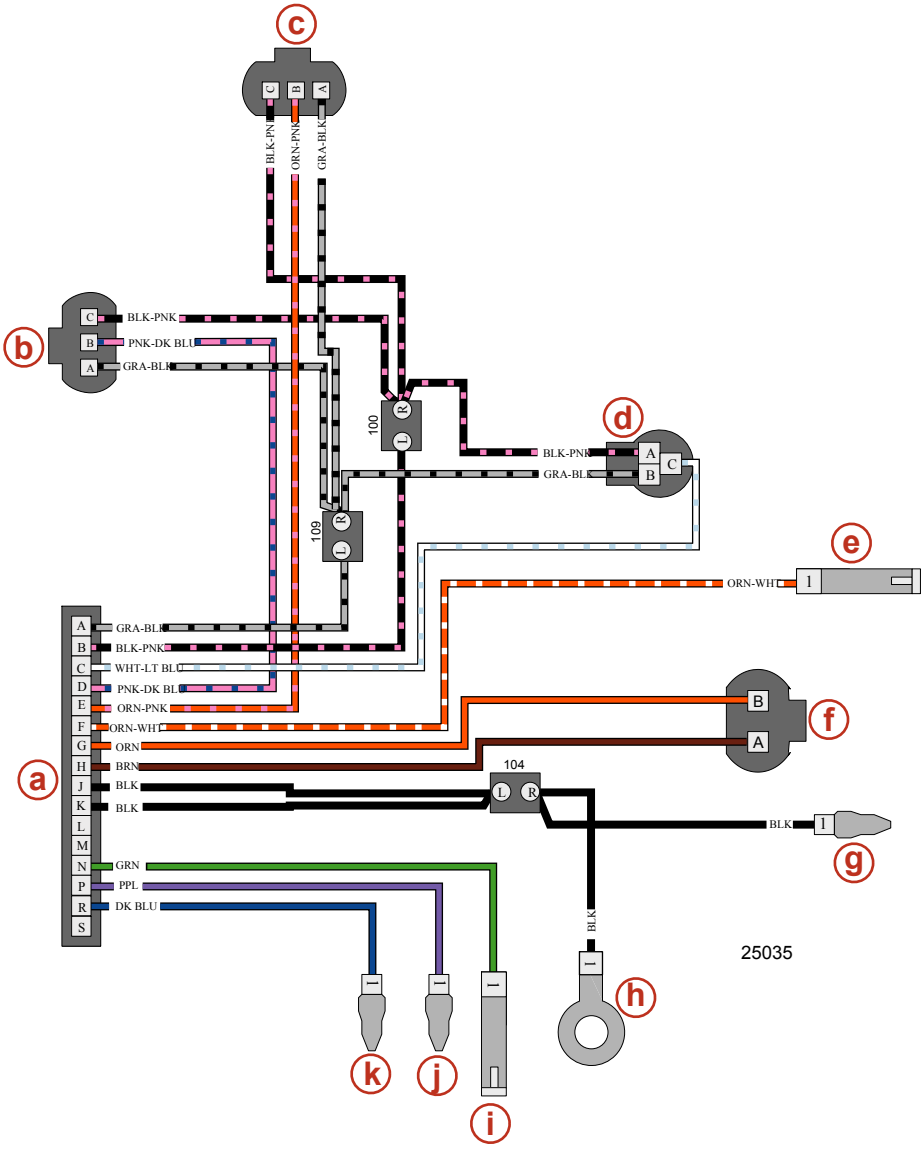


a - 16 Pin transom harness to engine harness connector
b - Steering connector
c - Digital trim sensor
d - Pitot sensor
e - Analog trim
f - MerCathode
g - Analog trim ground
h - Transom assembly ground
i - Trim down to pump
j - Trim relay power
k - Trim up to pump

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the EFI harness and the inner transom.

A malfunction in the transom harness will set the fault of Trim CKT HI, Trim CKT LO, Steering Angle Input HI or Steering Angle Input LO.

Transom Circuit (Transom Harness)—Sterndrive Mechanical

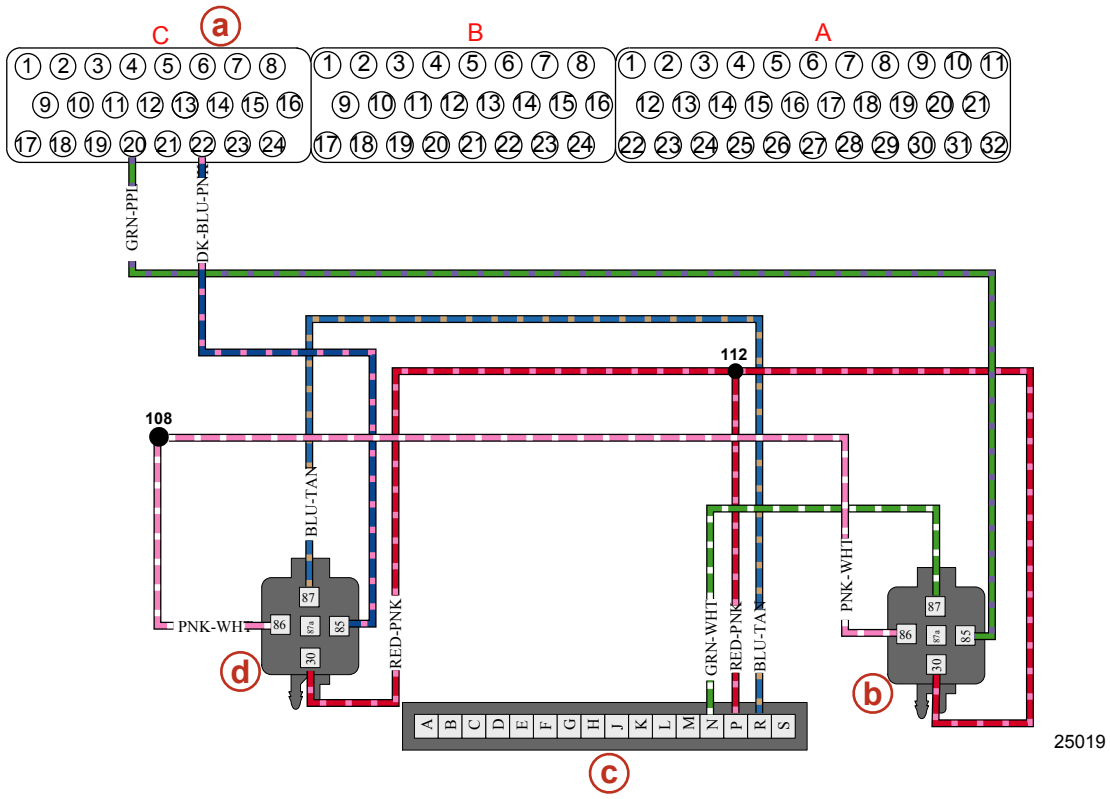


a - 16 Pin transom harness to engine harness connector
b - Steering connector
c - Digital trim sensor
d - Pitot sensor
e - Analog trim
f - Mercathode
g - Analog trim ground
h - Transom assembly ground
i - Trim down to pump
j - Trim relay power
k - Trim up to pump

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the EFI harness and the inner transom.

A malfunction in the transom harness will set the fault of Trim CKT HI, Trim CKT LO, Steering Angle Input HI or Steering Angle Input LO.

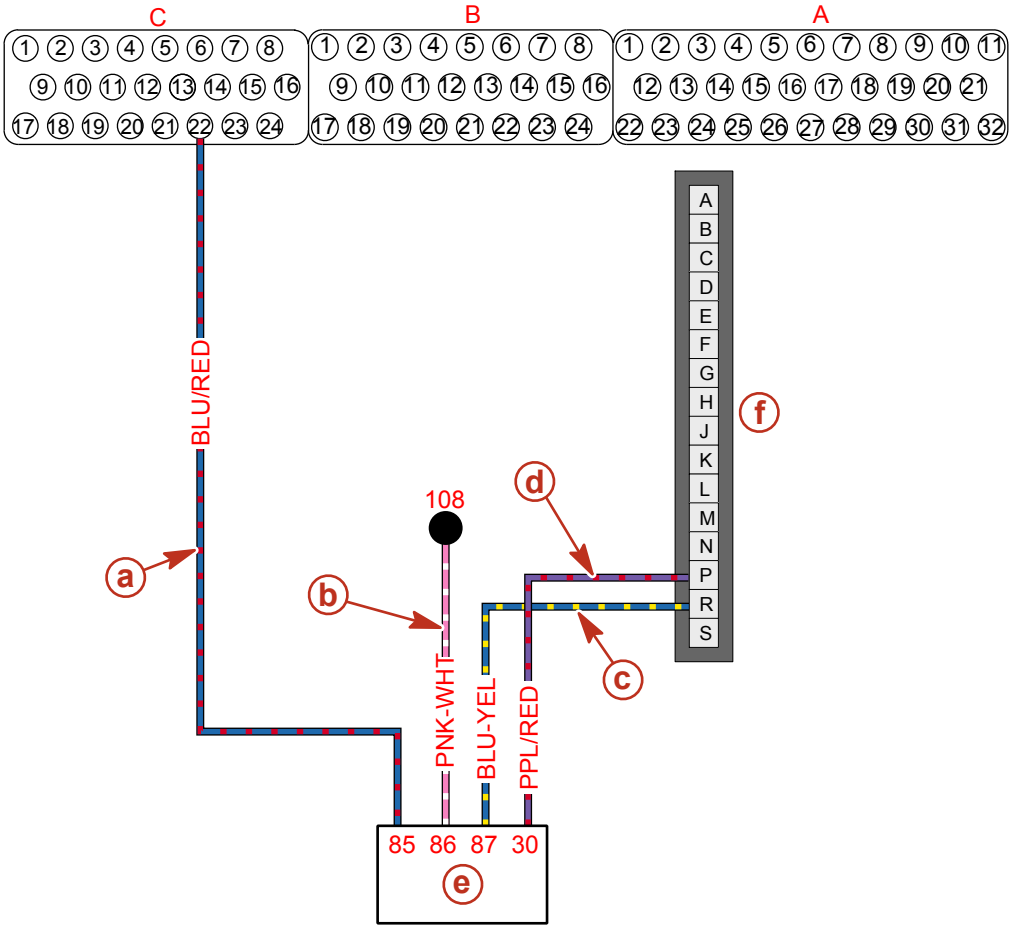
Trim Relay Circuit—DTS



a - PCM connector
b - Trim-down relay
c - Transom connector
d - Trim-up relay

The trim relay circuit receives power through splice 108 and 112, and is controlled by the PCM. The relay is located on the upper, port side of the engine.

Trim Up Relay Circuit—Mechanical



a - Reference
b - 12 Volt power to trim up relay
c - Trim up signal
d - 12 Volt power to Smart Transom
e - Trim up relay
f - 16 Pin transom connector

The trim relay circuit receives power through Splice 86 and 30. The PCM opens the relay to limit the amount of trim. It is located on the upper port side of the engine.

Notes:

Diagrams

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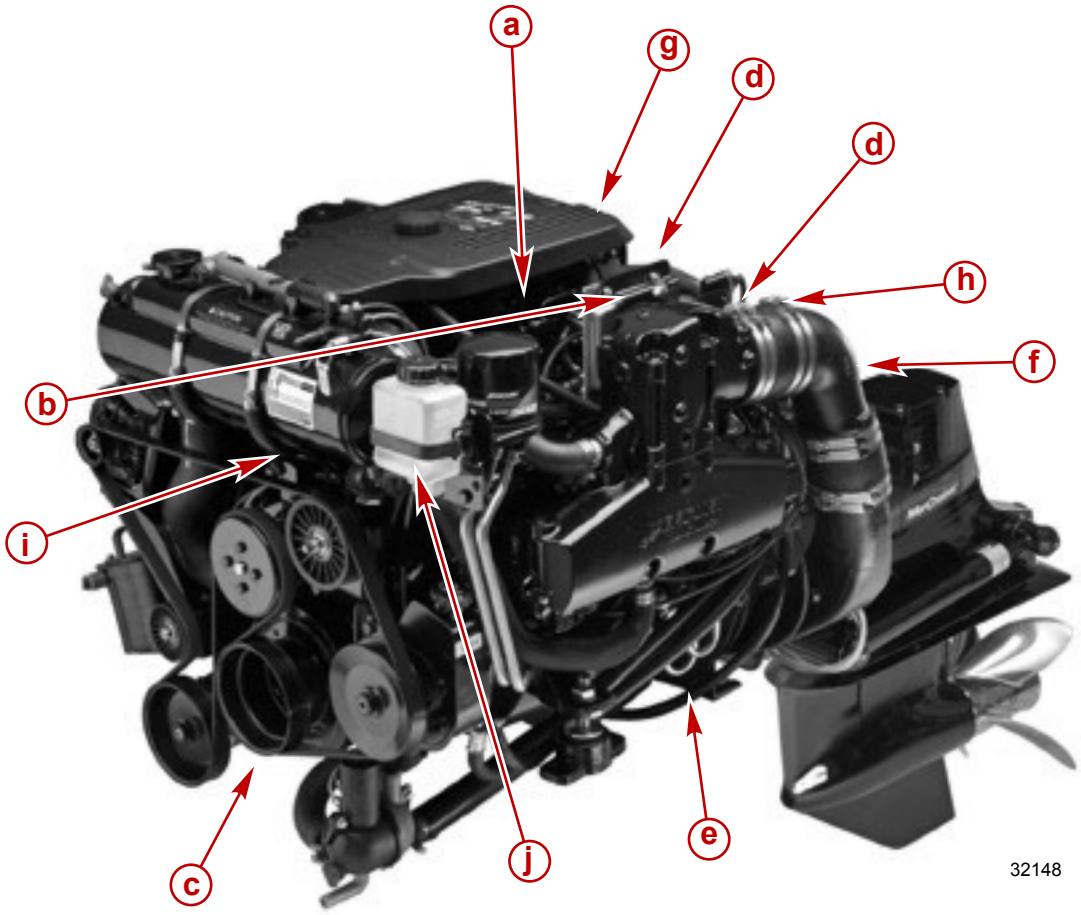
Sensor Locations—DTS

Sensors related to the PCM 555 wiring covered in this section are located as shown.



- **a -** Throttle position sensor (TPS)
- **b -** Electronic control module (PCM)
- **c -** Crankshaft position sensor (CPS)
- **d -** Data link connector (DLC)—under engine cover
- **e -** Oil pressure sensor
- **f -** Camshaft position sensor (CMP)
- **g -** Temperature and manifold absolute pressure sensor (TMAP)
- **h -** Seapump pressure sensor—on fluid cooler
- **i -** Engine coolant temperature sensor (ECT)
- **j -** Gear lube monitor

Engine Harness

Wiring Color Legend

Wire Label	Wire Color
BLU	Blue
DK BLU	Dark Blue
LT BLU	Light Blue
BLK	Black
GRA or GRY	Gray
GRN	Green

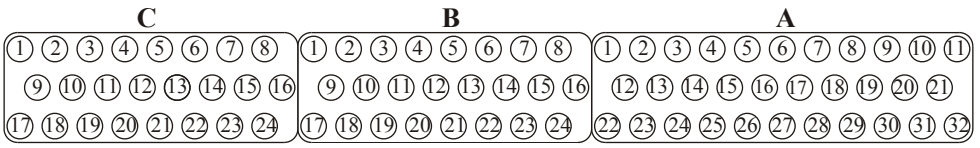
Wire Label	Wire Color
DK GRN	Dark Green
ORN	Orange
PPL or PUR	Purple
RED	Red
TAN	Tan
WHT	White
YEL	Yellow

Wire Splice Description—DTS 5.0, 5.7, and 6.2

Splice Number	Description
100	5 volt transducer ground
101	5 volt transducer power for sensors
102	Wake line, fused 20 amp, 12 volt power (key on only)
103	Clean (continuous) 12 volt power
104	Battery ground (-), 12 volt
105	Main Power Relay output (key on only), 12 volt
107	Power to PCM, fused 12 volt
108	Fused, switched 12 volt
109	Power 2
110	50 A fused, unswitched
111	Can 2 –
113	Can 2 +
114	Tachometer lead

PCM 555 Pinout-DTS

This is a quick reference guide to the pins of the PCM as viewed from the PCM 555 harness connectors. These tables can be used to identify the pins and the circuits that they connect. The tables may assist in checking the wiring for continuity to and from suspect sensors.



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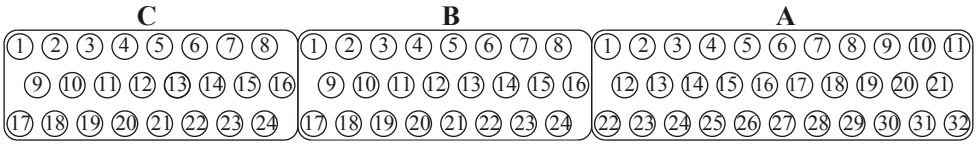
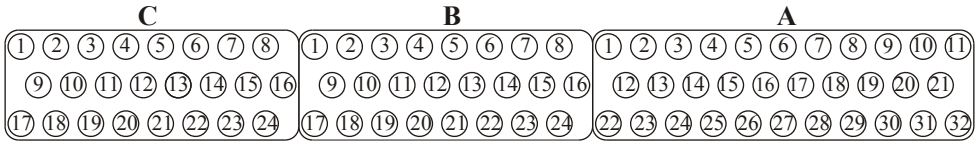
Connector A—DTS 5.0, 5.7, and 6.2

Mercury Part Number		8M2000472	8M2000470
Pin		Inboard—DTS (14 pin)	Sterndrive—DTS (14 pin)
A1	Key-on Power (Wakeup)	PPL	PPL
A2	Shift Position (From ESC)	LT BLU/GRN	LT BLU/GRN
A3	MAP Signal	LT GRN	LT GRN
A4	Oil Pressure Signal	BLU/BLK	BLU/BLK
A5	Pitot Signal	WHT/LT BLU	WHT/LT BLU
A6	Throttle Position Sensor 1 Signal	DK BLU/ORN	DK BLU/ORN
A7	Throttle Position Sensor 2 Signal	BLK/BLU	BLK/BLU
A8	Digital Trim Signal	ORN/LT BLU	ORN/LT BLU
A9	Starboard Tab Position Signal	Empty	Empty
A10	Port Tab Position Signal	Empty	Empty
A11	CAN Line 1 Pos (+)	WHT	WHT
A12	Steering Position (Smart Transom)	PNK/DK BLU	PNK/DK BLU
A13	Seawater Temperature Signal	WHT/YEL	WHT/YEL
A14	MAT Signal	TAN/YEL	TAN/YEL
A15	ECT Signal	YEL	YEL
A16	Port EMCT Signal	Empty	Empty
A17	Starboard EMCTSignal	Empty	Empty
A18	Scan (–)	WHT/PPL	WHT/PPL
A19	Port Knock Sensor 1 (–)	ORN/BLK	ORN/BLK
A20	Starboard Knock Sensor 2 (–)	YEL/WHT	YEL/WHT
A21	CAN 1 Line Neg (–)	LT BLU	LT BLU
A22	Sender Ground	BLK/PNK	BLK/PNK
A23	Sender Power	GRY	GRY
A24	Seapump Signal	DK BLU/WHT	DK BLU/WHT
A25	Fuel Level 2 Signal	LT BLU/BLK	LT BLU/BLK
A26	Fuel Level 1 Signal	PNK/BLK	PNK/BLK
A27	Empty	Empty	Empty
A28	Scan (+)	WHT/BLK	WHT/BLK
A29	Port Knock Sensor 1 (+)	BLK/ORN	BLK/ORN
A30	Starboard Knock Sensor 2 (+)	BLU/YEL	BLU/YEL
A31	CAN 2 Pos (+)	GRN/ORN	GRN/ORN
A32	CAN 2 Neg (–)	GRN/RED	GRN/RED



Connector B—DTS 5.0, 5.7, and 6.2

Mercury Part Number		8M2000472	8M2000470
Pin		Inboard—DTS (14 pin)	Sterndrive—DTS (14 pin)
B1	EST Return	Empty	Empty
B2	EST Coil 1 Trigger	WHT/GRN	WHT/GRN
B3	Paddle Wheel Signal	YEL/GRY	YEL/GRY
B4	Main Power Relay Control	PPL/DK GRN	PPL/DK GRN
B5	Empty	Empty	Empty
B6	CMP Signal	PPL/RED	PPL/RED
B7	IAC Valve Control	Empty	Empty
B8	Assist Solenoid	YEL/BLK	YEL/BLK
B9	EST Coil 5 Trigger	Empty	Empty
B10	EST Coil 3 Trigger	Empty	Empty
B11	Fuel Pump Relay Control	GRN/BLK	GRN/BLK
B12	Tachometer	GRY/WHT	GRY/WHT
B13	Empty	Empty	Empty
B14	CPS Signal	TAN/BLK	TAN/BLK
B15	Gear Position Switch Signal	Empty	YEL/PNK
B16	Drive Lube Monitor Or Trans Oil Temp Switch	DK BLU/BRN	DK BLU/BRN
B17	MPR Output (to PCM)	PNK/LT GRN	PNK/LT GRN
B18	MPR Output (to PCM)	PNK/LT GRN	PNK/LT GRN
B19	Empty	Empty	Empty
B20	Fuel Injector 4	LT GRN/ORN	LT GRN/ORN
B21	Warning Horn	Empty	Empty
B22	Fuel Injector 3	LT GRN/LT BLU	LT GRN/LT BLU
B23	E-Stop (thru CAN)	GRN/YEL	GRN/YEL
B24	Power 2 (SmartcCraft Sensors)	GRY/BLK	GRY/BLK

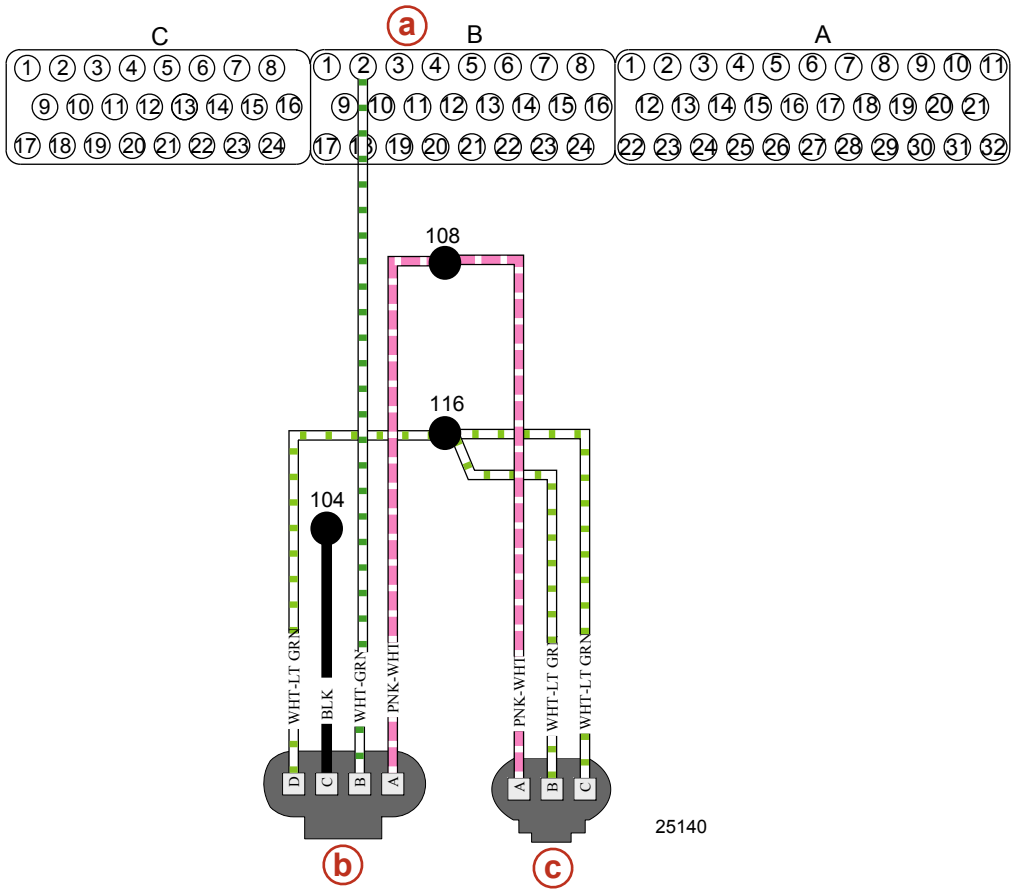


Connector C—DTS 5.0, 5.7, and 6.2

Mercury Part Number		8M2000472	8M2000470
Pin		Inboard—DTS (14 pin)	Sterndrive—DTS (14 pin)
C1	Port Tab Up Solenoid	Empty	Empty
C2	ETC Pin 3 (Driver)	PPL/WHT	PPL/WHT
C3	Fuel Injector 8	LT GRN/DK BLU	LT GRN/DK BLU
C4	ETC Pin 5 (Driver)	LT BLU/WHT	LT BLU/WHT
C5	Fuel Injector 7	LT GRN/BLK	LT GRN/BLK
C6	Fuel Injector 1	GRN/BLU	GRN/BLU
C7	EST Coil 4 Trigger	Empty	Empty
C8	EST Coil 2 Trigger	Empty	Empty
C9	Starboard Tab Up Solenoid	Empty	Empty
C10	Starboard Tab Down	Empty	Empty
C11	Fuel Injector 2	LT GRN/PPL	LT GRN/PPL
C12	EST Coil 6 Trigger	Empty	Empty
C13	EST Coil 7 Trigger	Empty	Empty
C14	EST Coil 8 Trigger	Empty	Empty
C15	Ground	BLK	BLK
C16	Ground	BLK	BLK
C17	ESC Pin D (Driver)	RED/GRN	RED/GRN
C18	ESC Pin E (Driver)	YEL/GRN	YEL/GRN
C19	Port Tab Down Solenoid	Empty	Empty
C20	Trim Down Relay Control	Empty	GRN/PPL
C21	Fuel Injector 6	LT GRN/RED	LT GRN/RED
C22	Trim Up Relay	Empty	DK BLU/PNK
C23	Fuel Injector 5	LT GRN/WHT	LT GRN/WHT
C24	Ground	BLK	BLK

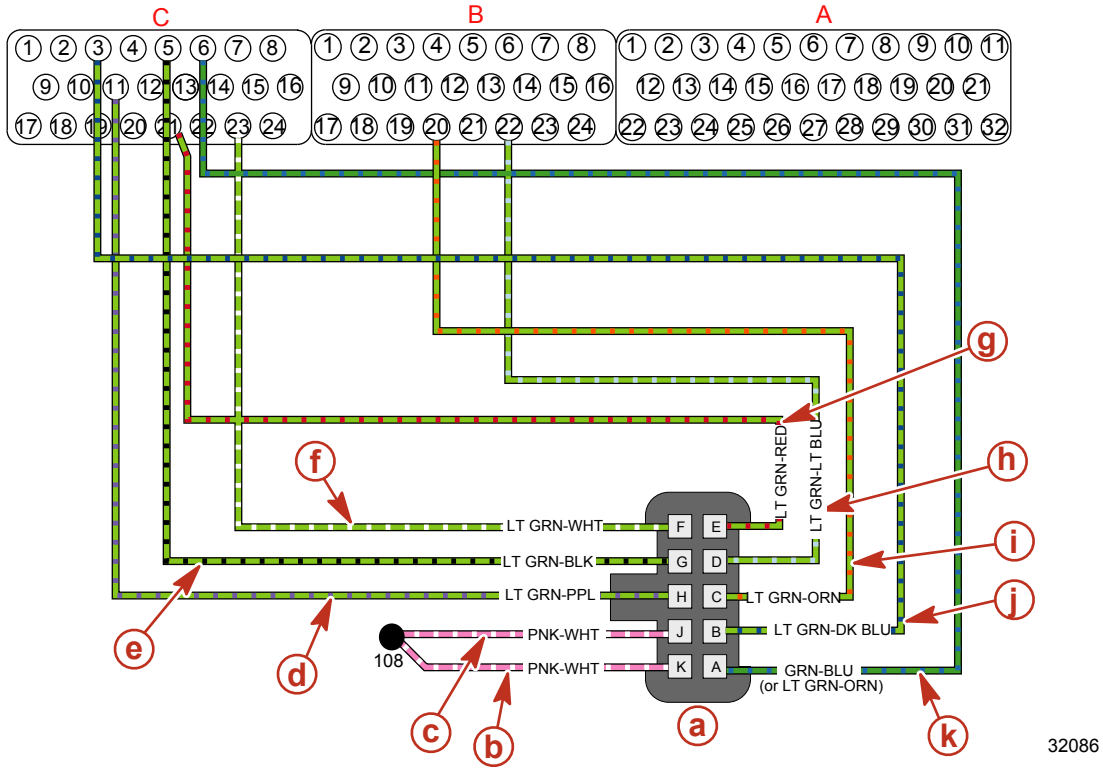
Wiring Diagrams

Coil Harness Circuit—5.0, 5.7, 6.2



a - PCM connector B
b - Coil driver
c - Ignition coil

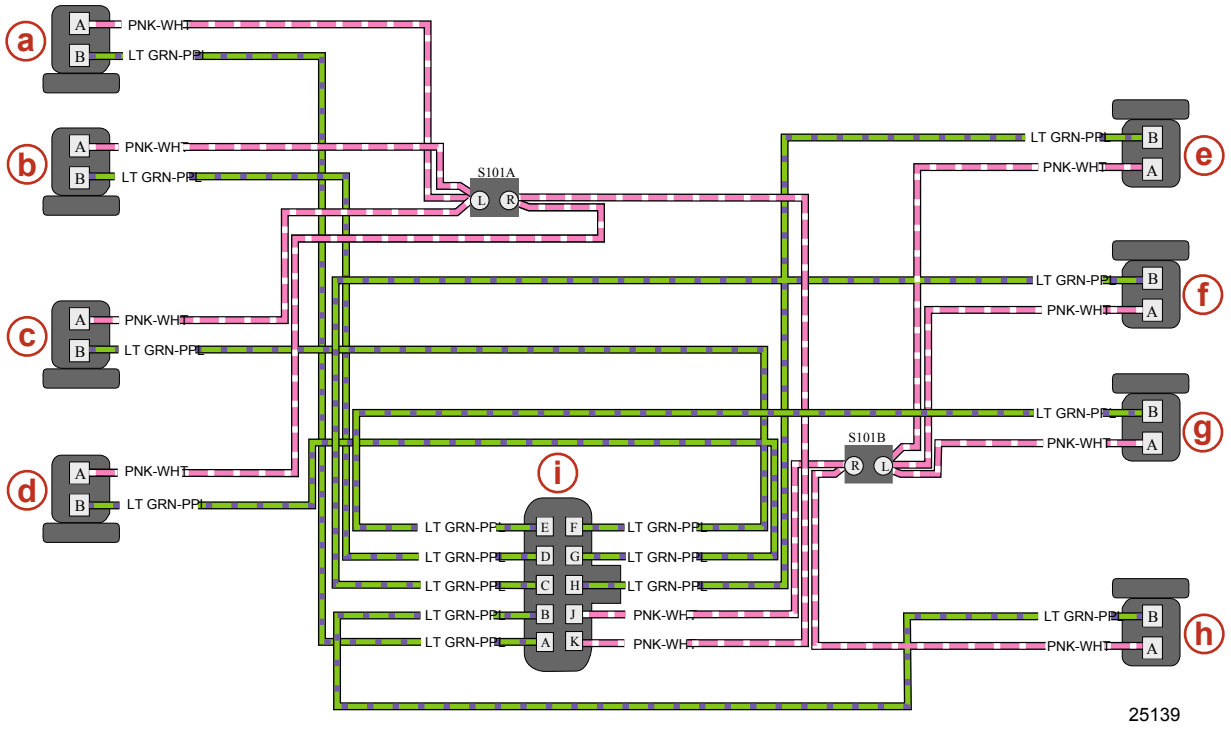
Fuel Injector Circuit (Engine Harness)—5.0, 5.7 and 6.2



a - Engine harness to fuel injector harness connector
b - Injector 1
c - Injector 8
d - Injector 6
e - Injector 4
f - Injector 3
g - Injector 5
h - Injector 7
i - Injector 2
j - 12 Volt fused power to injectors (splice 108)
k - 12 Volt fused power to injectors (splice 108)

The fuel injectors receive fused 12 volt power on pins J and K of the engine harness connector from the splice 108. The PCM signals the injectors to activate by pulling the 12 volt to ground and completing the circuit through the engine harness and injector harness.

Fuel Injector Circuit (Injector Harness)—5.0, 5.7, 6.2



a - Injector 1
b - Injector 3
c - Injector 5
d - Injector 7
e - Injector 2
f - Injector 4
g - Injector 6
h - Injector 8
i - Injector Connector

The fuel injectors receive fused 12 volt power from Splice 108 of the engine harness (pins J and K) on the injector harness. The PCM signals the injector to fire by pulling the 12 volt to ground and completing the circuit.

A malfunction in the fuel injector harness will set the fault of FINJ 1-8 Open or FINJ 1-8 Short.

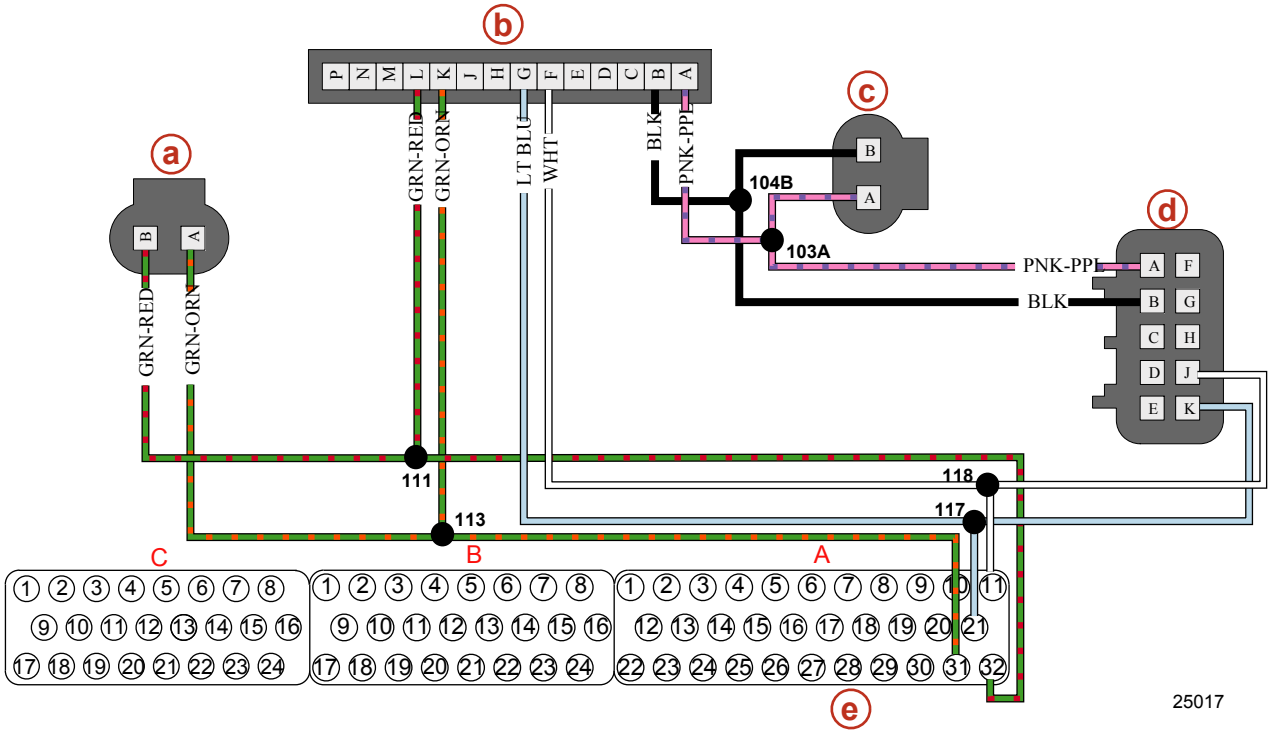
When the fuel injector driver wire is shorted to ground, the scan tool will read Open Sensor, this means that the fuel injector is full Open.

When the fuel injector is shorted, the scan tool will read Short Injector.

Single Circuit Diagrams

This section outlines the circuitry of the wiring harness and sensors as individual systems. This allows for a quick reference point when trying to detect a faulty connection. However, the complete system wiring diagram should be referenced if multiple electrical faults are occurring.

Control Area Network (CAN) Circuit—DTS

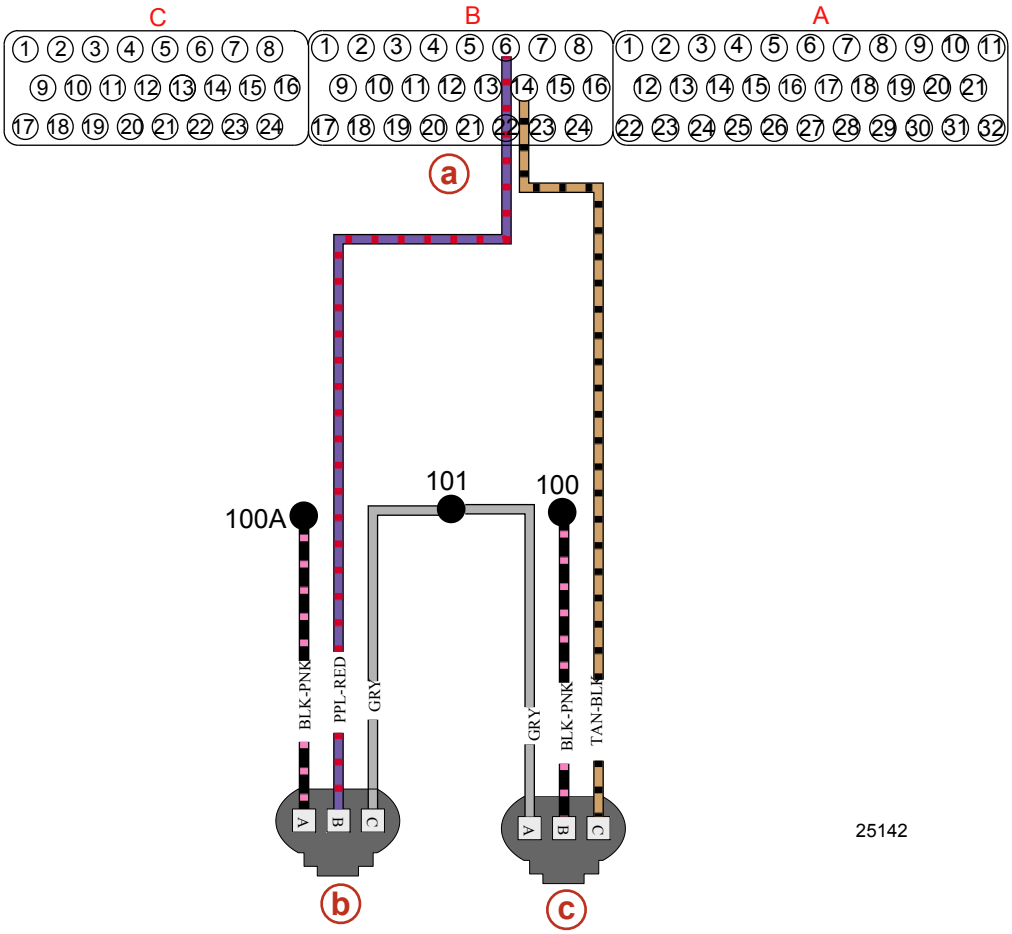


a - Can 2 resistor
b - 14-pin connector
c - Clean power
d - Can 1 terminator
e - PCM Connector

The CAN circuit supplies information to all SmartCraft gauges and System View. Gauge information (RPM, TEMP, TRIM) is sent through the CAN 1 leads.

The ETC and ESC are controlled through CAN 2.

Crank Position Sensor (CPS) and Camshaft Position Sensor (CMP) Circuits—Mechanical 5.0, 5.7, and 6.2



a - PCM connector B
b - Crankshaft position sensor (CPS)
c - Camshaft position sensor (CMP)

The crankshaft position sensor (CPS) is located at the timing chain cover on the front of the engine. It is a three-wire, Hall Effect sensor that keeps track of the crankshaft position and engine RPM. Signals are created in the sensor by a four-vane reluctor wheel mounted on the end of the crankshaft, behind the timing chain cover, that rotates past the sensor. The CPS signals to the PCM 555 that the crankshaft is positioned with pistons 1 and 6, 8 and 5, 4 and 7, or 3 and 2 at TDC. It can not tell which one of each pair is on the compression stroke and which one is on the exhaust stroke.

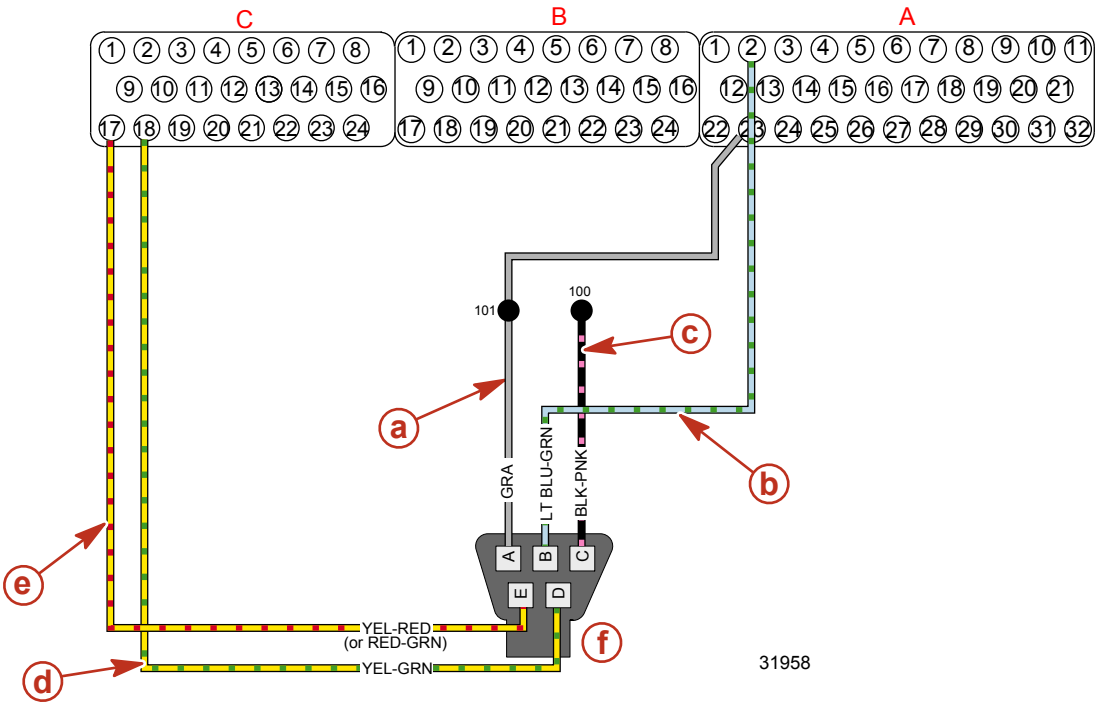
If the CPS pulses are not present the engine will not run.

The camshaft position sensor (CMP) is mounted inside of the high voltage switch (HVS) [distributor]. It is installed on all DTS engines that use this ignition system. It is a three-wire, Hall Effect sensor. The CMP signal is compared with the CPS signal by the PCM 555. This allows the PCM 555 to determine which one of each pair of pistons (1 and 6, 8 and 5, 4 and 7, or 3 and 2) is at TDC, on the compression stroke. This information is used to provide extra control of the eight fuel injector drivers and the ignition system, and to more accurately report engine knock information to the PCM 555.

The lack of a CMP signal may result in a longer crank time since the PCM cannot determine the cycle of the piston stroke.

The CPS will set a fault if out of synchronization. The CMP will set a fault if the circuit is shorted or open.

Electronic Shift Control (ESC) Circuit—Inboard

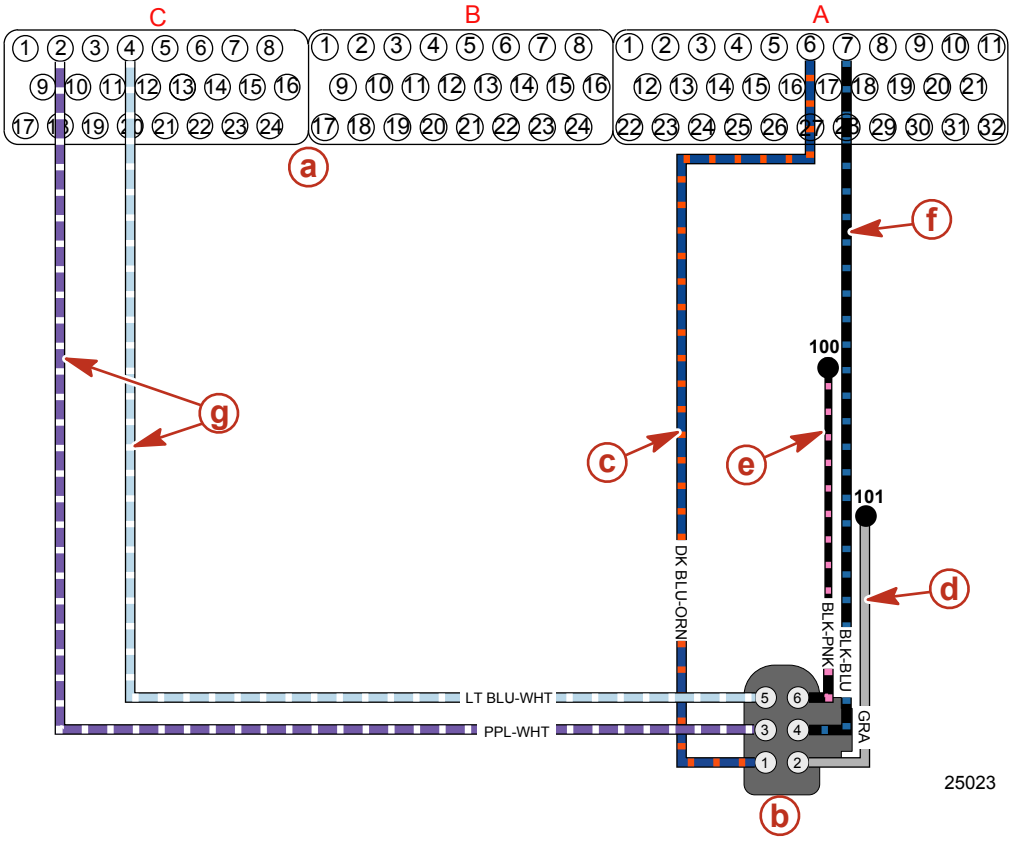


a - Power 1 (5 volt)
b - Shift position signal
c - Sensor ground (–)
d - Motor B
e - Motor A
f - ESC harness connector

The electronic shift control (ESC) circuit on a DTS inboard model powers the hydraulic solenoids on the transmission to shift the transmission into forward, neutral, and reverse gears without mechanical cables from the shift and throttle controls.

A malfunction in the ESC circuit on an inboard model will set faults indicating that the shift pressure sensor is not operating properly.

Electronic Throttle Control (ETC)—Sterndrive and Inboard DTS

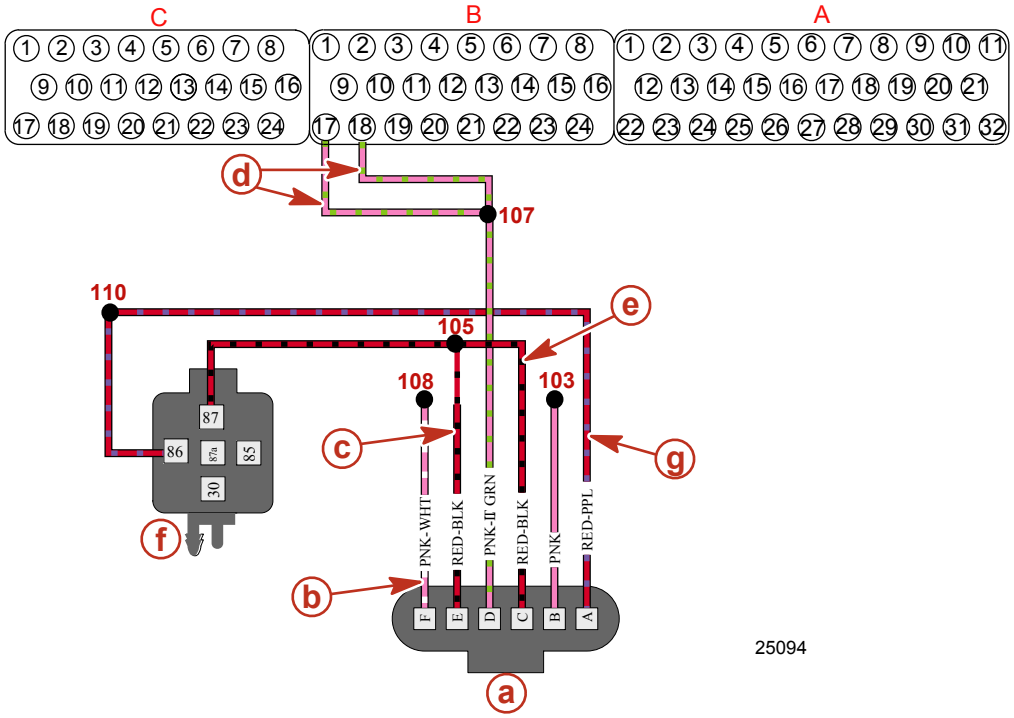


a - PCM connectors
b - Electronic throttle control
c - Signal wire TPS 1
d - 5 Volt power 1
e - 5 Volt ground
f - Signal wire TPS 2
g - Shift signal

A malfunction in the Throttle Position Sensor (TPS) circuit will set a fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo, ETC Sticking, TPS No Adapt, and TPS 1and 2 Difference Fault.

The TPS sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at wide open throttle on TPS 1 and 4.7 volts at idle to 0.5 volts at wide open throttle on TPS 2.

Fuse Circuit—DTS

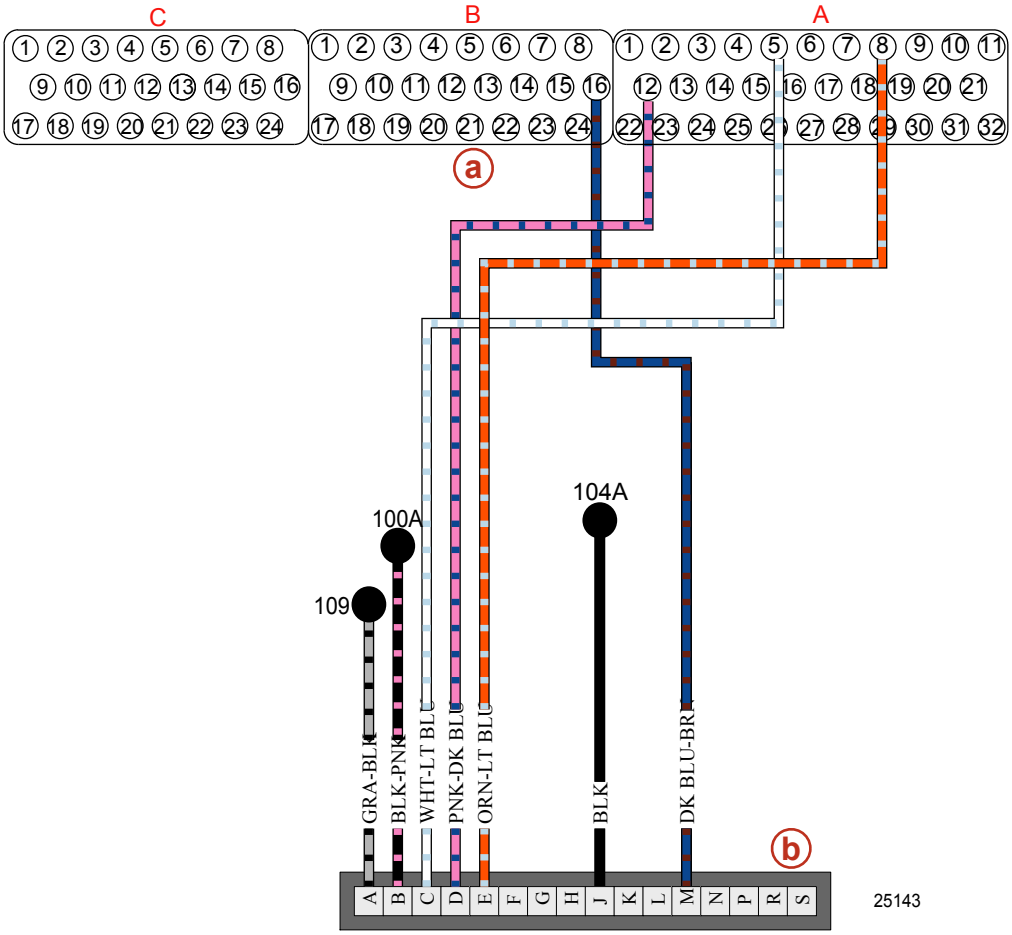


a - Fuses
b - 12 Volt power to fuel injectors
c - Battery power
d - 12 Volt power to PCM
e - Battery power
f - Fuel pump relay
g - Battery power

The fuse circuit receives 12 V battery power through splices 110 and 105. The fuse circuit is located on the upper port side of the engine. The protected power is sent to the PCM, fuel injectors, and fuel pump relay.

A malfunction in the fuse circuit will not set a fault.

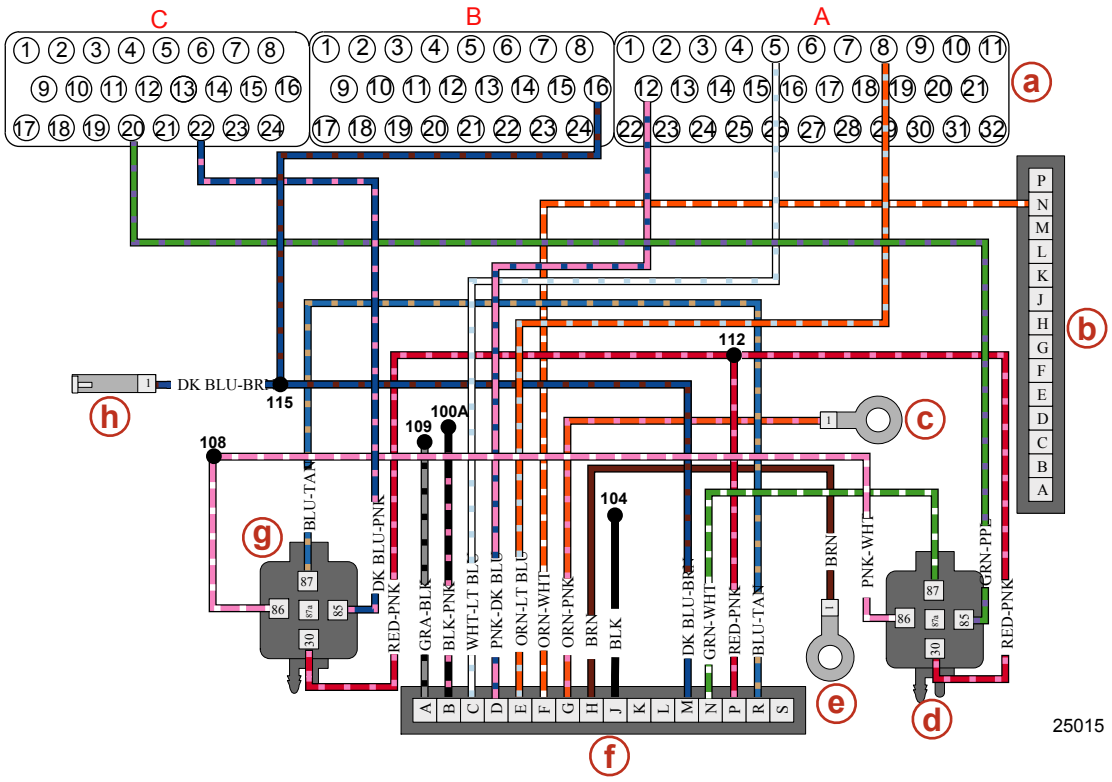
Smart Transom Circuit—DTS Inboard



a - PCM connectors

b - 16 Pin smart transom connector

Smart Transom Circuit—DTS Sterndrive



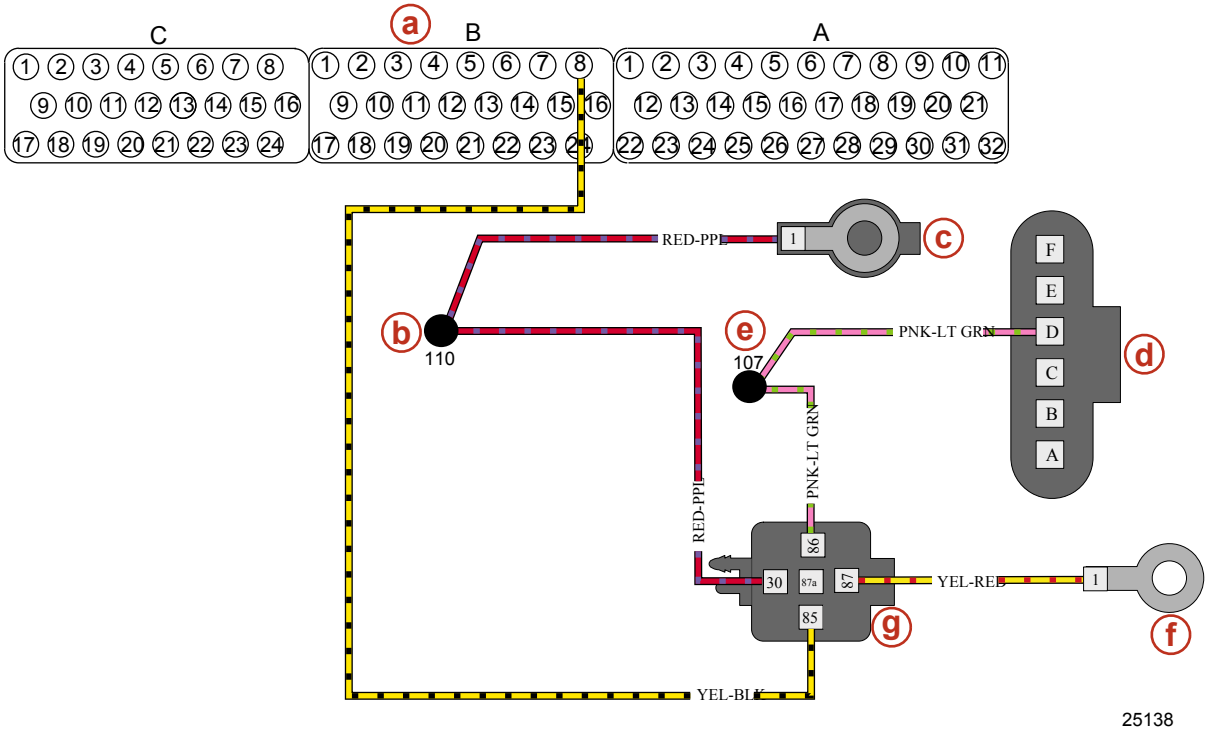
a - PCM connector A
b - 14 pin connector
c - MerCathode anode
d - Trim down relay
e - Mercathode reference electrode
f - Transom connector
g - Trim-up relay
h - Lube

The smart transom harness connection is located at the top of the engine. The harness controls communication between the transom sensors and the PCM. Pin A supplies 5 V power to the trim position sensor, pitot, and steering.

A malfunction in the smart transom circuit will set a fault of Pitot CKT Hi, Pitot CKT Lo, Steer CKT Hi, Steer CKT Lo, Trim CKT Hi or Trim CKT Lo, or many other faults.

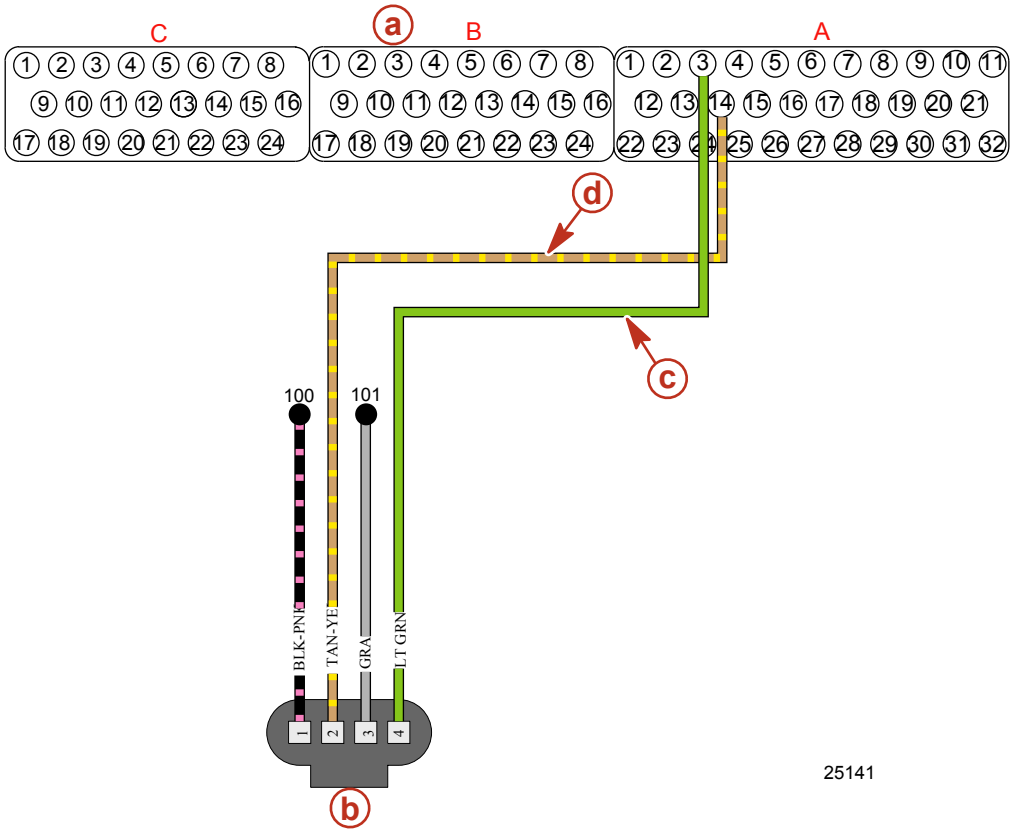
The trim and Mercathode components are connected through the transom connector.

Start Relay Circuit—DTS



a - PCM connector B
b - Splice 110
c - Circuit breaker, 50A
d - Fuse block
e - Splice 107
f - Starter "S" stud
g - Starter relay

Temperature and Manifold Absolute Pressure Sensor (TMAP) Circuit—5.0, 5.7, and 6.2



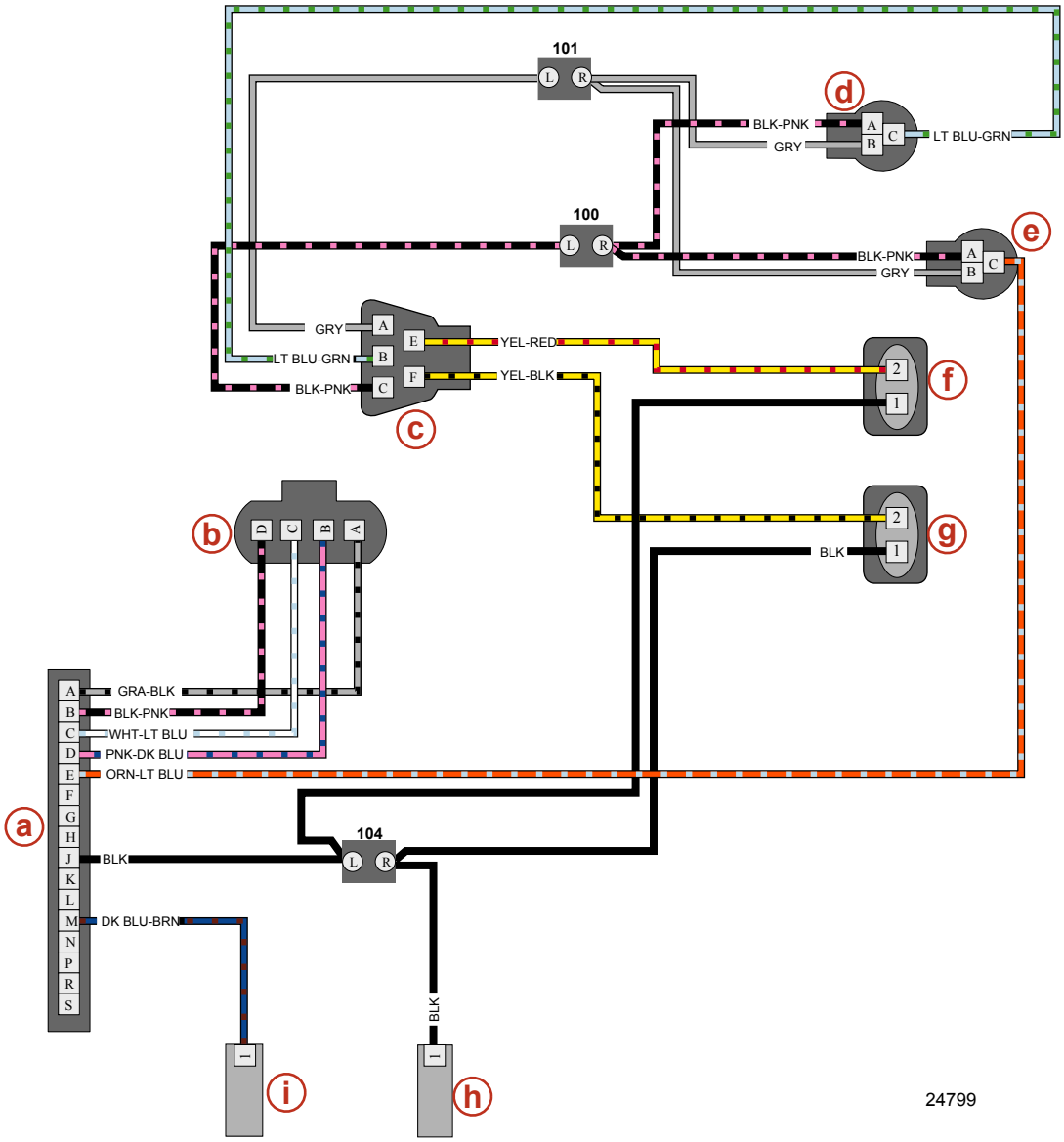
a - PCM connector A
b - TMAP
c - MAP signal wire
d - MAT signal wire

The temperature and manifold absolute pressure sensor (TMAP) is a combined MAT and MAP sensor. The TMAP is located on the intake manifold on the top of the engine. It contains a 2-wire sensor (MAT) and a 3-wire sensor (MAP) in a single housing. There is a common ground for both sensors.

The manifold air temperature sensor (MAT) is a thermistor that controls signal voltage to the PCM. When intake air is cold, the sensor resistance is high (a higher signal voltage is sent to the PCM). As the air temperature rises, sensor resistance lowers (a lower signal voltage is sent to the PCM).

The manifold absolute pressure (MAP) sensor measures the changes in the intake manifold pressure. At key on, the MAP is equal to atmospheric pressure. This information is used by the PCM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading with a known good TMAP sensor is a good check of a suspect sensor. The BARO reading only occurs at key on. As the engine is running the pressure changes as a result of engine load and speed change. The PCM receives this information as a signal voltage that will vary from about 1.0-2.0 volts at idle to about 4.0-5.0 volts at WOT.

Transom Circuit (Transom Harness)—Inboard DTS

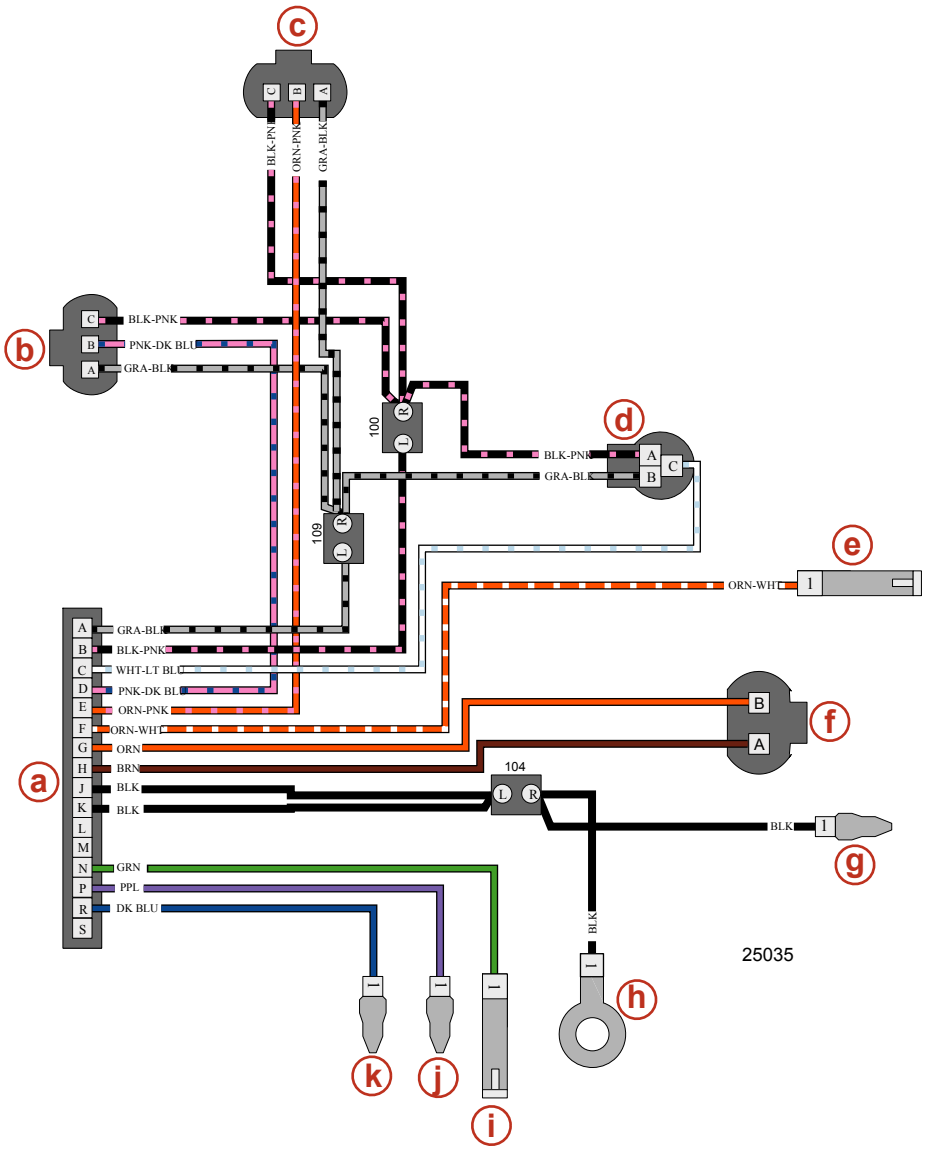


a - 16 Pin connector
b - Steering and pitot connector
c - Transmission shift harness connector (ESC)
d - Pressure A connector
e - Pressure B connector
f - Shift solenoid A connector
g - Shift solenoid B connector
h - Overtemp switch ground (–)
i - Transmission overtemp switch

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the EFI harness and the transmission.

A malfunction in the transom harness will show pressure faults and shift faults.

Transom Circuit (Transom Harness)—Sterndrive DTS

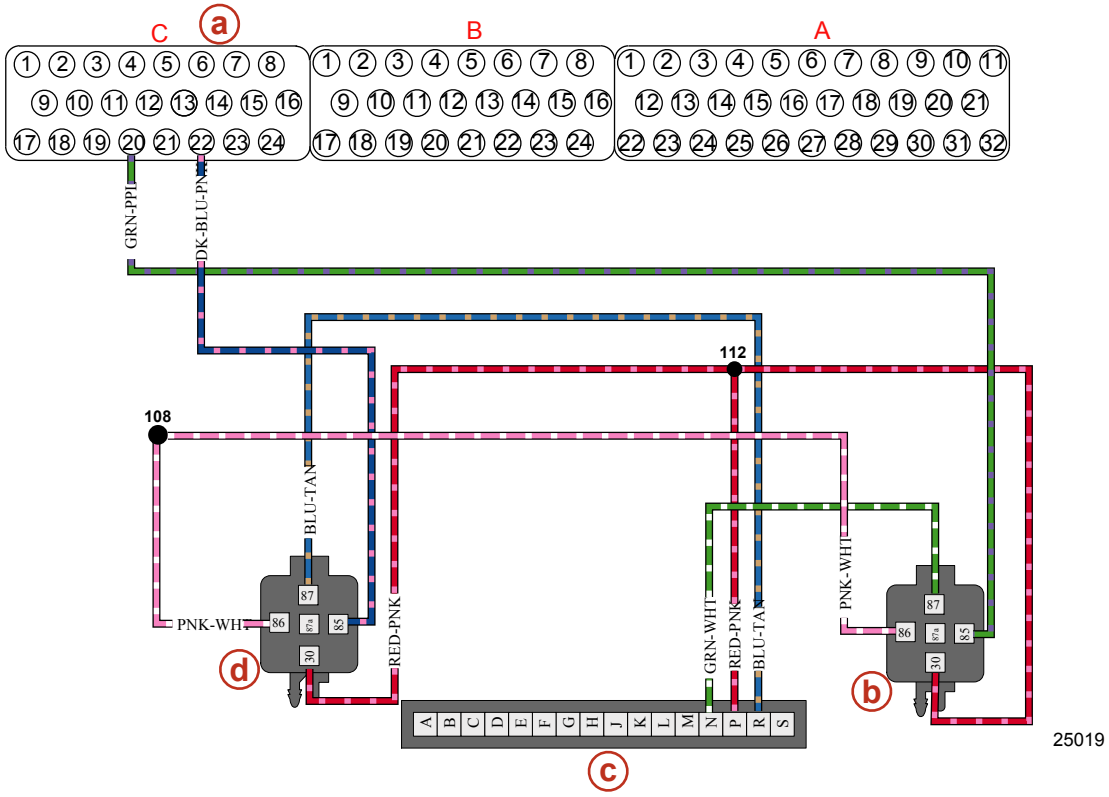


a - 16 Pin transom harness to engine harness connector
b - Steering connector
c - Digital trim sensor
d - Pitot sensor
e - Analog trim
f - MerCathode
g - Analog trim ground
h - Transom assembly ground
i - Trim down to pump
j - Trim relay power
k - Trim up to pump

The transom harness has multiple leads that connect to sensors in the transom assembly. It is located on the rear of the engine between the EFI harness and the inner transom.

A malfunction in the transom harness will set the fault of Trim CKT HI, Trim CKT LO, Steering Angle Input HI or Steering Angle Input LO.

Trim Relay Circuit—DTS



a - PCM connector
b - Trim-down relay
c - Transom connector
d - Trim-up relay

The trim relay circuit receives power through splice 108 and 112, and is controlled by the PCM. The relay is located on the upper, port side of the engine.

Notes: